Fundamental Limits of Full-Duplex Spectrum Sharing under Peak Interference Power Constraint

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Abstract

In order to effectively solve the problem of spectrum shortage, cognitive radio (CR) and full-duplex (FD) have been proposed and widely studied in recent year. In this paper, we integrate CR and FD techniques, consider a FD spectrum sharing CR networks, where both secondary users (SU1 and SU2) are equipped with dual antennas, one of which is used to receive signals, and the other is used to transmit signals at the same time and frequency. Under peak interference power and peak transmit power constraints, we analysis the ergodic sum capacity and the outage probability based on the FD spectrum sharing CR networks and the conventional spectrum sharing CR networks. Furthermore, under no peak transmit power constrain and perfect self-interference cancellation (SIC), based on the FD spectrum sharing CR networks and the conventional spectrum sharing CR networks, the closed-form expressions of the theoretical upper bound of the ergodic sum capacity and the outage probability are derived by two lemmas and four propositions. Accurate mathematical analysis display, under the same bandwidth, the upper bound of the full-duplex spectrum sharing CR networks ergodic sum capacity is twice as much as the traditional spectrum sharing CR networks, and the FD spectrum sharing CR networks based on SU1, also has better upper bound performance on the outage probability than the traditional spectrum sharing CR networks. Simulations results validate that, the FD spectrum sharing CR networks obtains better communication performance than the conventional spectrum sharing CR networks, especially when the residual self-interference is small. Finally, we also can see that the simulation upper bound is completely consistent with the theoretical analysis upper bound, whether in the FD spectrum sharing CR networks or the conventional spectrum sharing CR networks. So also verifies the correctness of the theoretical upper bound derivation.

Full Text

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Figures

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FD spectrum sharing CR networks

Figure 2

Conventional spectrum sharing CR networks

Figure 3

Ergodic sum capacity versus peak interference power constraint under $P_{pk} \leq 1$ for the FD spectrum sharing CR networks and the conventional spectrum sharing CR

Figure 4

Ergodic sum capacity versus peak interference power constraint under different peak transmit power constraint and perfect SIC for the FD spectrum sharing CR networks

Figure 5

Ergodic sum capacity versus peak transmit power constraint under different peak interference power constraint and perfect SIC for the FD spectrum sharing CR networks

Figure 6

Ergodic sum capacity versus peak interference power constraint and peak transmit power constraint under perfect SIC for the FD spectrum sharing CR networks

Figure 7

Outage probability versus peak interference power constraint under $P_{pk} \neq 1$ for SU1 of the FD spectrum sharing CR networks and the conventional spectrum sharing CR networks

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Outage probability versus peak interference power constraint under different peak transmit power constraint and perfect SIC for SU1 of the FD spectrum sharing CR networks

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Outage probability versus peak transmit power constraint under different peak interference power constraint and perfect SIC for SU1 of the FD spectrum sharing CR networks

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Outage probability versus peak interference power constraint under different target rate, perfect SIC and $P_{pk} \neq 1$ for SU1 of the FD spectrum sharing CR networks

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