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Sum Rate Characterization of Joint Multiple Cell-Site Processing *

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Abstract

The sum-rate capacity of a cellular system model is analyzed, considering the uplink and downlink channels, while addressing both non-fading and flat-fading channels. The focus is on a simple Wyner-like multi-cell model, where the system cells are arranged on a circle, assuming the cell-sites are located at the boundaries of the cells. For the uplink channel, analytical expressions of the sum-rate capacities are derived for intra-cell TDMA scheduling, and a "Wide-Band" (WB) scheme (where all users are active simultaneously utilizing all bandwidth for coding). Assuming *individual per-cell power constraints*, and using the Lagrangian uplink-downlink duality principle, an analytical expression for the sum-rate capacity of the downlink channel is derived for non-fading channels, and shown to coincide with the corresponding uplink result. Introducing flat-fading, lower and upper bounds on the average per-cell sum-rate capacity are derived. The bounds exhibit an $O(\log_e K)$ multi-user diversity factor for a number of users per-cell $K \gg 1$, in addition to the array diversity gain. Joint multi-cell processing is shown to eliminate out-of-cell interference, which is traditionally considered to be a limiting factor in high-rate reliable communications.

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