

## **Distributed Multi-Cell Zero-Forcing Beamforming in Cellular Downlink Channels**

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### **Abstract**

For a multiple-input single-output (MISO) downlink channel with  $M$  transmit antennas, it has been recently proved that zero-forcing beamforming (ZFBF) to a subset of (at most)  $M$  “semiorthogonal” users is optimal in terms of sum-rate, asymptotically with the number of users. However, determining the subset of users for transmission is a complex optimization problem. Adopting the ZFBF scheme in a cooperative multi-cell scenario renders the selection process even more difficult since more users are likely to be involved. In this paper, we consider a multi-cell cooperative ZFBF scheme combined with a simple sub-optimal users selection procedure for the Wyner downlink channel setup. According to this sub-optimal procedure, the user with the “best” local channel is selected for transmission in each cell. The performance of this sub-optimal scheme is investigated in terms of both, the conventional scaling law of the sum-rate with the number of users, and a sum-rate offset. We term this characterization of the sum-rate for large number of users as high-load regime, and point out the similarity of this approach with the standard affine approximation used in the high-SNR regime. It is shown that under an overall power constraint, the sub-optimal distributed multi-cell ZFBF scheme achieves the same sum-rate growth rate and slightly degraded offset law, when compared to an optimal scheme deploying joint multi-cell dirty-paper coding (DPC) techniques, asymptotically with the number of users per cell. Moreover, the overall power constraint is shown to ensure in probability equal per-cell power constraints when the number of users per-cell increases.