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Model Based on Matern Process for ICI Mitigation in Multi Cell Cooperation

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Abstract—Ever increasing need of data rate and coverage can be achieved by mitigating the impairments of wireless communication system. Inter cell interference (ICI) is one of the most challenging impairment of wireless communication. To mitigate ICI, multi cell cooperation (MCC) based technique has been proposed in literature. In this paper, ICI mitigation is achieved by using Matérn Hard-Core Point Process (MHCP) instead of Poisson point process (PPP). In MHCP a minimum distance between base stations is maintained. Therefore, MHCP corresponds to real deployment scenario. Also, use of MHCP reduces the analytical complexity significantly compared to that of PPP. A closed form expression for complementary cumulative distribution function (CCDF) of signal-to-interference ratio is derived using MHCP for MCC based system in terms of number of base stations, number of antennas and path loss. Using derived expression of CCDF, analytical expressions for probability density function and ergodic capacity is also presented in the closed form. Finally, performance analysis is shown in terms of ergodic capacity. Results are validated by comparing the proposed results with [4].

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1. INTRODUCTION

Different impairment mitigation techniques have been proposed in literature to achieve ever increasing demand of higher data rate. Among others, inter cell interference (ICI) is one of the most challenging impairment of wireless communication system. Multi cell cooperation (MCC) is one of the ICI mitigation techniques [1, 2]. In general, Poisson point process (PPP) has been used to model the positioning of the BSs in cellular system [3]. But, recently Matérn hard-core point process (MHCP) has been proposed as an alternative to PPP [4]. To explore MHCP instead of PPP for ICI mitigation is a key motivation of this paper.

Stochastic geometry and associated techniques have been applied in different wireless networks such as in cellular, cognitive and relay networks in order to capture the real scenario as accurately as possible [5, 6]. MCC is one of the techniques based on stochastic geometry and base station (BS) cooperation. As discussed above MCC is used to mitigate ICI in dense cellular networks [1, 7]. Basically, in MCC joint encoding or decoding of the signals at the BSs is performed using the high-capacity backhaul, results in a significant improvement in throughput. In addition, MCC is used to improve coverage, cell-edge capacity, and spectral efficiency. Further for larger and highly utilized communication system, MCC technique has superior performance compared to frequency reuse and power control techniques.

Recent studies [4, 8] show that MHCP [9] may be used in place of PPP to model the location of BS in a cellular network. Actually, in PPP based positioning the location of BSs is independent of each other [2]. But this does not correspond to a real scenario, as the BSs locations are not totally independent of each other in actual cellular networks. Most importantly, as the location of BSs in PPP based distribution is independent of each other they may be situated very closely. This causes significantly limited coverage area.

This paper removes the shortcomings of the system [2] by using MHCP [10] in place of PPP distribution. In MHCP a minimum distance between BSs is maintained which is the real scenario. Also, using MHCP analytical complexity has been reduced significantly compared to that based on PPP based distribution in [2]. In addition, use of MHCP results in ICI mitigation in MCC based system. Therefore, this paper presents closed form expressions for CCDF, PDF and ergodic capacity using MHCP for MCC based cellular system. This paper is the extended version of [11, 12].

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