Notification No.: 555/2024

Date of Award: 20-03-2024

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Topic of Research: Some Techniques for Performance Improvement in LTE-A Mobile Networks

Findings

The interference is a major issue that impairs the performance of cellular systems and needs a proper treatment to attain the anticipated outcomes from a mobile network. There are different types of interference in different environments that may impact the performance of a cell user. In this work, we particularly focus on mitigation of inter-cell interference (ICI) in both homogeneous and heterogeneous mobile networks (HetNets). We suggest few strategies that aim to improve the performance of users located at the cell-edges since such users are prone to high ICI from nearby cells. We emphasize mainly on coordinated multipoint (CoMP) which is a dynamic cell-coordination approach that offers several benefits compared to the conventional static and semi-static schemes. CoMP is unique in handling ICI as it has characteristics that can effectively supress or even exploit the interference as a useful signal thereby improving cell-edge throughput, spectral efficiency and coverage. However, CoMP faces several challenges including stringent requirements for high capacity backhaul, precise synchronization and increased complexity which require attention to exploit its full potential. To address aforementioned issues associated with CoMP we develop some strategies which provide performance improvement compared to the existing approaches.

- First, we design a low complexity precoding technique which is based upon the signal-to-leakage-plus-noise ratio (SLNR) based metric. The proposed scheme exploits the characteristics of SLNR based model in the CoMP enabled homogenous networks and offers decreased computation cost, improved noise performance and exemption from the antenna related conditions of conventional schemes. We compare the outcomes of proposed scheme with existing multi-cell schemes based on signal-to-interference-plus-noise ratio (SINR), zero forcing (ZF) and block diagonalization (BD)

metrics' and show that proposed approach provides higher performance gains.

- Next, we design an adaptive and backhaul efficient scheme for CoMP enabled homogenous networks that makes an efficient utilization of backhaul capacity by selecting one of the appropriate CoMP schemes from joint transmission CoMP (JT-CoMP) and coordinated scheduling/coordinated beamforming (CS/CBF-CoMP) schemes by taking into account the sum rate and the available backhaul capacity. The proposed algorithm endeavours to exploit the favourable features of the two schemes and provides improved performance compared to the standalone schemes in the constrained backhaul network scenarios. In this context, we also suggest an approach that reduces backhaul overhead by making judicious selection of the coordination cells in a CoMP cluster. This mechanism attempts to decrease the number of coordination cells in a cluster with minimal impact on the performance. The reduced number of cluster cells results in reduced amount of coordination signalling overhead that leads to improved network performance. Both the proposed schemes are viable solutions for the network scenarios with limited-backhaul capacity.
- HetNet is a widely used approach to achieve increased capacity and coverage in the cellular networks. However, interference is more pronounced in HetNets due to large number of closely spaced small-cells. The conventional enhanced inter-cell interference coordination (eICIC) scheme is able to manage the interference in HetNets but only by sacrificing time or frequency resources. Additionally, it is unable to cope with the ICI in fast varying channels due to lack of dynamism. The CoMP, is a dynamic solution with improved spectral efficiency, however, it has its own limitations as mentioned earlier. To reduce the limitations of the above two schemes, we propose a hybrid strategy that conjoins the features of time domain eICIC scheme and the JT-CoMP scheme to improve the performance in diversified and backhaul-constrained HetNets. The proposed scheme algorithm makes intelligent and appropriate selection between the two schemes in a way that backhaul is used more efficiently with the aim of maximizing sum rate and spectral efficiency. The application of CoMP on top of eICIC provides significant improvement in the cell-edge performance compared to the standalone eICIC scheme. Furthermore, we suggest a backhaul efficient HetNet-CoMP framework to improve the interference performance of CoMP aided multi-HetNet dense network scenarios.

The proposed strategies in our work not only improve the interference performance of CoMP enabled long term evolution-advanced (LTE-A) based fourth generation (4G) systems but are equally useful for forthcoming 5G and beyond network deployment scenarios.