On Demand Deployment of UAV Base Stations in Wireless Communication Networks

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Abstract

Unmanned aerial vehicles (UAVs)-assisted communication systems are considered a promising technology in diverse verticals. The objective of this research is to study on demand deployment of UAVs in special applications. We analyze the multi-UAV deployment in two different scenarios.

First, we analyze the deployment of UAVs as an aerial base stations (ABSs) to provide cellular coverage to isolated users. The main contributions of this study includes a less complex approach to optimally position the UAVs and assigning user equipment (UE) to each ABS, such that the total spectral efficiency (TSE) of the network is maximized, while maintaining a minimum QoS requirement for the UEs. The main advantage of the proposed approach is that it only requires the knowledge of UE and ABS locations and statistical channel state information. We propose two approaches with common and diverse altitude selection. Both approaches lead up to approximately 8-fold energy savings compared to ABS placement using a naive exhaustive search.

Second, we have investigated the deployment of UAVs in wireless sensor network (WSN) systems. Considering the energy-constrained nature of the WSN, we have proposed a multi-UAV deployment algorithm that minimizes the maximum power transmitted among the sensor nodes (SN) for given data rate and altitude constraints. The problem is divided into three subproblems in order to reduce the complexity. Each subproblem is optimized by fixing other parameters as constant. Finally, we proposed a joint optimization algorithm that combines the approaches of all three subproblems. In the joint optimization, the first and second subproblems are iteratively solved together while third subproblem is solved independently for each UAV. Moreover, the joint optimization gives the minimum number of UAVs required to serve all the SNs with the given constraints. The results indicate a significant performance gain compared to the benchmark methods in terms of the number of iterations for convergence, maximum transmission power requirement and the minimum number of UAV requirements.

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