Energy-Efficient Cooperative Relaying for Unmanned Aerial Vehicles

Airborne relaying can extend wireless sensor networks (WSNs) to remote human-unfriendly terrains. However, lossy airborne channels and limited battery of unmanned aerial vehicles (UAVs) are critical issues, adversely affecting success rate and network lifetime, especially in real-time applications. We propose an energy-efficient cooperative relaying scheme which extends network lifetime while guaranteeing the success rate. The optimal transmission schedule of the UAVs is formulated to minimize the maximum (min-max) energy consumption under guaranteed bit error rates, and can be judiciously reformulated and solved using standard optimisation techniques. We also propose a computationally efficient suboptimal algorithm to reduce the scheduling complexity, where energy balancing and rate adaptation are decoupled and carried out in a recursive alternating manner. Simulation results confirm that the suboptimal algorithm cuts off the complexity by orders of magnitude with marginal loss of the optimal network yield (throughput) and lifetime. The proposed suboptimal algorithm can also save energy by 50 percent, increase network yield by 15 percent, and extend network lifetime by 33 percent, compared to the prior art.