LEACH had the earliest first death and the largest first-last death difference; the EEUC saw early deaths of all network sensors, despite a small first-last death difference; the UCRA achieved longer survival time of sensors than the two contrastive protocols. The excellent performance of the UCRA can be explained as follows: To solve the hot-spot problem, the UCRA requires that the ring closer to the base station be narrower, such that the sensors close to the base station will not face energy depletion due to data transmission. As a result, the intra-cluster energy consumption of the UCRA is lowered. Besides, more cluster heads are elected to share the energy consumption.

5. CONCLUSIONS

Drawing on clustering routing algorithms like LEACH and EEUC, this paper puts forward the UCRA to extend the survival time of sensors and balance the energy consumption across the WSN. The UCRA firstly initializes the network and divides the monitoring area into several rings by concentric circles. Then, the cluster heads are elected based on the residual energy and local ring. In the clustering phase, each sensor joins a suitable cluster based on its local ring and the distance between the cluster head and the centerline of the ring. Before inter-cluster transmission, the neighboring cluster heads with the most residual energy in the previous ring are selected as the routing sensors. The simulation results show that the UCRA can effectively extend the survival time of network sensors and balance the energy consumption across the network.

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