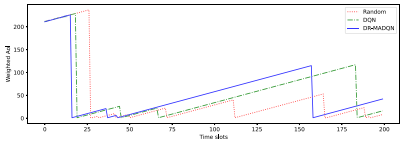
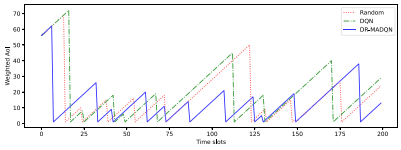
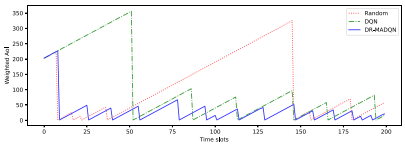


(a) AoI of IoT devices with low priority.

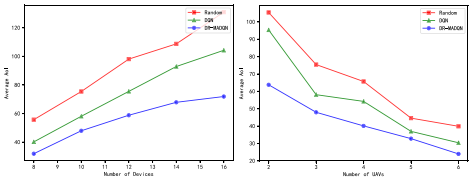


(b) AoI of IoT devices with medium priority.



(c) AoI of IoT devices with high priority.

Fig. 4. AoI of IoT devices with different priority.



(a) Average AoI versus the number of IoT devices. (b) Average AoI versus the number of UAVs.

Fig. 5. Average AoI versus the IoT device and UAV number.

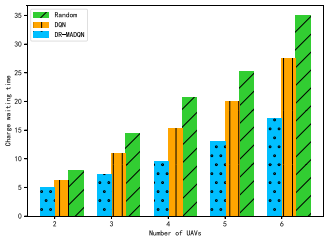


Fig. 6. Average charge waiting time versus the UAV number.

random-target-selection scheme, respectively. In Figure 5(b), increasing UAV density results in a decrease in average AoI, with DR-MADQN consistently maintaining the lowest average AoI.

Figure 6 shows the average charge waiting time of the UAVs when the number of the UAVs increases. Compared with the benchmark schemes, the DR-MADQN can decrease the average charge waiting time by up to 38.20% and 51.43%. Meanwhile, DR-MADQN has a relatively smaller increase in charge waiting time when the number of the UAVs increases.

V. Conclusion

In this letter, we address energy-limited UAVs in IoT data collection, where only one UAV can be charged at one time slot. We have formulated this problem into an optimization model to minimize the average AoI of IoT devices. Our proposed DR-MADQN significantly decreases the average AoI and the charge waiting time compared to benchmark schemes. For future work, we can consider a time-varying priority of devices, whereby the location of the HAP could be optimized based on the changing priority of IoT devices.

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