Chapter 2. Related Works

2.1 Wireless Rechargeable Sensor Network

Currently, wireless charging technology can be divided into four categories [1]. The first category is magnetic induction, which transmits electrical energy wirelessly by magnetic induction, mainly through inductive coupling between the two coils. The alternating current in the transmission coil forms a shock magnetic field, and the receiving coil within the magnetic field induction range generates electromagnetic induction, which generates the induction current. The second category is magnetic resonance, a technique that enables the transmitter and receiver to reach a specific frequency, which in turn produces magnetic resonance and transmits energy. The most common applications of these two technologies are wireless charging for mobile phones. The third category is infrared, which is one of the most recent types of wireless charging to appear. What makes infrared charging unique compared to its competitors is that the energy (in the form of invisible light) is beamed very precisely towards the device being charged, whereas other long-distance methods tend to broadcast energy far and wide. This means charging is relatively efficient, and there are fewer safety concerns about energy spilling into the wider environment and potentially causing harm or interference. The final category is radio frequency, which is best for wearables and other small devices because they are not restricted to the size and shape of the coils in the same way as inductive charging. Radio frequency wireless charging technology utilizes radio frequencies also transmitted through a wireless charger and picked up by a receiver within the device that is then converted into DC voltage. This way, the transmitter and receiver are not restricted by measurements for effective wireless power transfer and do not necessitate alignment of the transmitter and receiver for effective charging.

2.2 Various Methods for wireless charging station deployment

In recent years, many methods have been applied to the deployment of wireless charging stations. Wei-Jhe Jian *et al.* [2] proposed a moveable-charger-based algorithm to find candidate nodes and find the final placements by greedy algorithm. Because the greedy algorithm easily falls into the local optimal solution in the NP hard problem. In order to reduce more deployment costs, we must find a better charging station deployment method and avoid the best solution to quickly fall into the local optimal. Metaheuristic algorithm is a good choice to avoid falling into the local optimal solution. In previous research, [3] used the concept of SA for charging station deployment design. The main concept of SABC is that he can accept candidate nodes with a small number of sensor nodes. At the beginning of the process, a charging station is randomly selected from the candidate nodes, and the temperature is determined during each iteration to decide whether to add a charging station or replace the original charging station. This method has more directions for finding a solution, so there is a higher chance of finding a good solution. However, during the SABC iteration process, unnecessary solutions are often found repeatedly. If unnecessary solutions can be eliminated in the process, the convergence of the algorithm can be accelerated. Therefore, in [4], the author uses layoffs algorithm to layoffs from solutions found in the process but eliminated. This method can prevent the algorithm from repeatedly finding bad solutions. The different from SABC is that LSABC initially treats all candidate nodes as all placements, and randomly selects one candidate point for each iteration to eliminate. If the result is better, it replaces the original solution. If not, the candidate point is retrenched. The result does indeed speed up the convergence time of the algorithm.

2.3 Non-dominated Sorting Genetic Algorithm-II

Deb *et al.* [5] proposed the non-dominated sorting genetic algorithm II (NSGA-II) algorithm to improve the non-dominated comparison operator to improve the algorithm execution efficiency, and added a crowded comparison operator to calculate the crowding distance of the solutions in the same level to determine the new parent, so that the optimal solution can be evenly distributed on the Pareto front.

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[2] W.-J. Jian, H.-H. Cho, C.-Y. Chen, H.-C. Chao, and T. K. Shih, "Movable-charger-based planning scheme in wireless rechargeable sensor networks," in *2015 IEEE Conference on Computer Communications Workshops (INFOCOM WKSHPS)*, 2015: IEEE, pp. 144-148.

[3] W.-C. Chien, H.-H. Cho, C.-Y. Chen, H.-C. Chao, and T. K. Shih, "An efficient charger planning mechanism of WRSN using simulated annealing algorithm," in *2015 IEEE International Conference on Systems, Man, and Cybernetics*, 2015: IEEE, pp. 2585-2590.

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[5] K. Deb, A. Pratap, S. Agarwal, and T. Meyarivan, "A fast and elitist multiobjective genetic algorithm: NSGA-II," *IEEE transactions on evolutionary computation,* vol. 6, no. 2, pp. 182-197, 2002.