Dear Dr. Tian and the anonymous reviewers,

On behalf of my co-authors, we express our sincere gratitude for providing us with the opportunity to revise our manuscript. We highly value the reviewers' insightful and constructive comments and suggestions on our manuscript titled "Maximum Allowable Current Determination of RBS By Using a Directed Graph Model and Greedy Algorithm" (ID:SPACE-D-23-00082).

We have thoroughly examined the reviewers' comments and have made revisions, which are indicated in red within the paper. We have made every effort to address the comments and improve our manuscript accordingly. Please find attached the revised version, which we kindly request you to consider.

We would like to extend our great appreciation to you and the reviewers for their valuable feedback on our paper. We eagerly await your response.

Thank you and best regards.

Dr. Cheng Qian, on behalf of all authors

Beihang University

2023.11.10

Authors' Response to Reviewer 1

Comment 1:

Grammatical and spelling errors are still observed. Please check and fix carefully.

Response:

We are sorry for our negligence of the grammatical and spelling errors, and have carefully checked the manuscript and corrected them.

Comment 2:

Since authors stated that there is no existing works on the MAC determination of RBSs that they could compare their solution with. So how the authors validate their works and their results.

Response:

We infer that the reviewer may desire to convey: since the authors stated that there are no existing works on the MAC determination of RBSs that they could compare their solution with, it is important to meticulously and comprehensively elucidate how the authors validate their works and the results.

To address the concern raised by the reviewer, we have incorporated a comprehensive discussion in the Case study section, specifically titled "Correctness of the results". In this part, we thoroughly examine the correctness of the results obtained through the proposed greedy algorithm from two distinct perspectives: circuit analysis and validation against the brute-force algorithm. Additionally, we have included a comparison between the proposed greedy algorithm and two heuristic algorithms, namely simulated annealing and genetic algorithm, in the revised manuscript. There is a reference ([35] in the manuscript) claiming that the path selection problem under consideration may be NP-hard. Therefore, it is reasonable to compare the performance of the proposed greedy algorithm with these heuristic approaches, which are commonly employed to tackle NP-hard problems. Remarkably, our results demonstrate that the proposed greedy algorithm consistently achieves the same or superior outcomes compared to the heuristic algorithms.

Here is the specific modification we made in the Discussion:

> The correctness of the outcomes provided by the proposed greedy algorithm will be discussed from two perspectives: circuit analysis and validation against the brute-force algorithm.Let's take the four-battery RBS structure shown in Fig. 4c as an example.When B_1 and B_2 or B_3 and B_4 are connected in parallel, the RBS produces the maximum current, which is $\eta = 2$ (i.e., twice the current output of a single battery in the RBS).Adding more batteries to the main circuit only creates a series structure and does not improve the MAC.Therefore, the switch-control scheme provided in Tab. 4 maximizes the RBS output current.On the other hand, the brute-force method, which examines all possible switch states, also yields the same η.This indicates that the proposed greedy algorithm successfully identifies the MAC among all the potential reconfigured structures.

And here is the comparison between the proposed greedy algorithm and the heuristic algorithms in the "Result":

> To verify and compare the proposed greedy algorithm, we also used the brute-force algorithm, which iterates through all possible switch states, and the heuristic algorithms (SA and GA) to calculate the MAC of the same RBSs.The final results of the brute-force algorithm are the same as the ones of the greedy algorithm, which are shown in Tabs. 2, 3, and 4.But, the brute-force algorithm counts all possible switch states, which equates to 2^{15}, 2^{13}, and 2^{19} structures, respectively.The two heuristic algorithms' temporal evaluation of the objective values during the iteration process are shown in Figs. 7a, 7b, and 7c, respectively, compared with the proposed greedy algorithm.Comparing to the SA and GA, the proposed greedy

algorithm solves the correct results with fewer iteration steps.

Comment 3:

Refer to the mentioned article as previously stated in comment 8 of the first revision.

Response:

We have reconsidered and modified the corresponding content about the analysis on MAC problem in the introduction. The mentioned article becomes important to this paper, therefore, we have cited it in the introduction and accept the reviewer's suggestion.

We have reevaluated and revised the relevant content regarding the analysis of the MAC problem in the introduction. The mentioned article holds significance in this paper, hence we have referenced it in the introduction and acknowledged the suggestion made by the reviewer.

Here is the specific modification we made in the introduction:

Unfortunately, there have been few studies proposed to directly determine the MAC of RBSs, primarily due to the complexity arising from reconfiguration.In the field of computer science, there is a similar problem of scheduling tasks on dynamically reconfigurable hardware with limited resources and task interdependencies, which is analogous to the determination of MAC.A corresponding method has been proposed [33, 34].However, dealing with the structural characteristics and circuit equations of RBSs is challenging for this method.

Authors’ Response to Reviewer 2

Comment 1:

The latest related works need to be reviewed carlfully please, expecicially the works published in recent year 2022,2023.

Response:

We concur with the reviewer’s assertion that it is important for our paper to undergo a thorough review of the most recent relevant literature. We have carefully scrutinized the pertinent works from the past five years and made appropriate revisions to the manuscript. In the "Introduction" section, we provide an overview of the challenges posed by the complex RBS structures in hardware design. Furthermore, the estimation and control of the system state of RBSs have been receiving increasing attention in recent time. Consequently, we have chosen several corresponding methodologies aimed at optimizing the system’s performance.

Here is the specific modification in the introduction:

> However, these complex structures between batteries and switches provide flexibility to RBSs while also posing challenges in hardware design.During the reconfiguration process, current deviation and fluctuation may occur. Specifically, when the system switches from series to parallel connection, circulating current between parallel cells can be triggered due to voltage imbalance [20]. Failure to fully consider this issue during the design of RBSs can result in damage to the batteries, switches, and wires.For example, Engelhardt et al. [21] applied RBS to a fast-charging scenario with adaptive cell switching, which can balance cell states while adhering to voltage requests. However, the switching of batteries leads to intolerable current variations.To address this problem, Han et al. [22] derived an analytical expression for the maximum switch current during battery system reconfiguration. This analytical expression aids in the selection of switches and supports the hardware design of RBSs.Recently, there has been increasing attention given

to the estimation and control of the system state of RBSs, and several approaches have been proposed to optimize the performance of the system.State estimation, which is an essential technology in traditional battery management systems, serves as the foundation for system control and holds great potential in the context of RBSs [23].Couto et al. [24] introduced a partition-based unscented Kalman filter to estimate the state of a large-scale RBS, utilizing an enhanced reduced-order electrochemical model.Kersten et al. [25] utilized the balancing current of neighboring cells in parallel operation to determine battery impedance, thereby obtaining information about the state of health and power capability.Schmid et al. [26] further leveraged the reconfigurable nature of the system to actively diagnose faults, employing an algorithm that changes the system structure to enhance fault isolability.Another active research topic is the development of effective control strategies for RBSs to achieve optimal performance, including improved stability [27] and efficiency [28].Han et al. [29] proposed a near-fastest battery balancing algorithm to minimize the time required for battery charge equalization.Liu et al. [30] also proposed a scheme for maximizing capacity utilization based on a path planning algorithm, aiming to enhance battery consistency within the system.To break through the bottleneck of the potential short-circuit paths increase exponentially with the RBS's scale, Chen et al. [31] proposed a systematic approach based on sneak circuit theory.They conducted a comprehensive analysis of all paths between the cathode and anode of each battery in the RBS, identifying paths that only consist of switches as short-circuit paths for pre-checking before system reconfiguration.Furthermore, Artificial Intelligence also appears in the RBS management [32].The effectiveness of deep reinforcement learning method has been validated in real-world RBSs [28].

Comment 2:

The greedy algorithm and the brute force algorithm are compared in this paper, but the advantages and disadvantages of this algorithm compared with other algorithms cannot be determined.

Response:

Thanks to the suggestion of the reviewer! We have revised the "Discussion" subsection and included a specific part to analyze the advantages and disadvantages of the proposed greedy algorithm in comparison to other algorithms. Based on our discussion and comparison, the proposed greedy algorithm demonstrates a significant advantage in terms of its effectiveness and efficiency. It is also capable of handling RBSs with diverse structures. However, this algorithm may encounter challenges when dealing with large-scale problems due to its exponential time complexity. Furthermore, the simplification of the derivation by assuming that all batteries are identical may introduce a slight bias to the MAC due to variations in open-circuit voltage u_b and internal resistance r_b in reality. We have also provided a solution to address this issue.

The relevant content has been added to the "Advantages and disadvantages of our method" part within the "Discussion" subsection. Once again, we appreciate this constructive comment from the reviewer.

Comment 3:

This paper mainly applies to the four-battery system, but the usability of other structures of RBS should also be discussed.

Response:

Thanks for the valuable feedback. We have thoroughly considered the comment made by the reviewer. In response, we have supplemented the case study with a series of experiments on RBSs with variant batteries. Overall, the proposed greedy algorithm has been applied to RBSs with three different structures, variant batteries, and scenarios involving random isolated batteries. The correctness and efficiency of the proposed greedy algorithm have been verified through the comparison with other algorithms.

The relevant content has been added to the "Case study" section. We hope it can address the reviewer's concerns.