

METHOD AND APPARATUS FOR OPTIMIZING ENERGY STORAGE SYSTEM, DEVICE, STORAGE MEDIUM AND PROGRAM PRODUCT

TECHNICAL FIELD

5 **[0001]** The present application relates to the field of energy storage control technologies, and in particular, to a method and apparatus for optimizing an energy storage system, a device, a storage medium and a program product.

BACKGROUND

10 **[0002]** With the development of energy storage technologies, an energy storage system, as an important part of smart grid and microgrid system, plays an increasingly important role.

15 **[0003]** Usually, the staff will monitor a working state of each container, a sub-system or a battery cluster by acquiring a rated power, a rated current, a charging efficiency and a discharging efficiency, or other parameters of each container, sub-system or battery cluster in the energy storage system, and optimize the energy storage system according to a monitoring result, such as replenishment or hardware replacement. However, in this monitoring method, an actual state of the battery in the energy storage system may not be accurately determined, thus making it impossible to find problem(s) of the battery system timely and effectively, thereby leading to a poor
20 optimization effect.

SUMMARY

[0004] The present application provides a method, an apparatus for optimizing

energy storage system, and a device, a storage medium and a program product to solve a problem of poor optimization effect of energy storage system in related art.

[0005] In a first aspect, the present application provides a method for optimizing an energy storage system, including:

5 in response to a detection instruction, acquiring configuration information of each of battery cells in a target station corresponding to the detection instruction;

computing actual state information of each of the battery cells according to the configuration information;

10 determining a to-be-optimized state of a group to which each of the battery cells belongs according to the actual state information of each of the battery cells;

in response to an optimization instruction, determining a target optimization group from groups and optimizing a battery cell in the target optimization group.

[0006] In one embodiment, before computing the actual state information of each of the battery cells according to the configuration information, the method further includes:

15 screening out abnormal data from the configuration information according to a preset information threshold;

cleaning the abnormal data, and sorting rest configuration information to obtain processed configuration information;

20 where the computing the actual state information of each of the battery cells according to the configuration information includes:

computing the actual state information of each of the battery cells according to the processed configuration information.

[0007] In one embodiment, the detection instruction carries a time period label;

25 where the acquiring configuration information of each of the battery cells in the target station corresponding to the detection instruction includes:

determining a target time period according to the time period label;

acquiring the configuration information of each of the battery cells during the target time period.

[0008] In one embodiment, the configuration information carries a generation time label;

where the cleaning the abnormal data, and sorting the rest configuration information to obtain the processed configuration information includes:

5 cleaning and filling the abnormal data to obtain cleaned configuration information;

 determining a generation time of the cleaned configuration information according to the generation time label carried in the cleaned configuration information, and sorting the cleaned configuration information according to the generation time to
10 obtain the processed configuration information.

[0009] In one embodiment, before computing the actual state information of each of the battery cells according to the configuration information, the method further includes:

 determining actual charge information of each of the battery cells at a
15 beginning of the target time period and actual charge information of each of the battery cells at an ending of the target time period according to the configuration information;

 where the computing the actual state information of each of the battery cells according to the configuration information includes:

 computing the actual state information of each of the battery cells according
20 to the configuration information, the actual charge information of each of the battery cells at the beginning of the target time period and the actual charge information of each of the battery cells at the ending of the target time period.

[0010] In one embodiment, the configuration information includes current information generated by each of the battery cells during the target time period;

25 where the computing the actual state information of each of the battery cells according to the configuration information, the actual charge information of each of the battery cells at the beginning of the target time period and the actual charge information of each of the battery cells at the ending of the target time period includes:

 determining a first reference value according to a difference value between

the actual charge information of each of the battery cells at the beginning of the target time period and the actual charge information of each of the battery cells at the ending of the target time period;

- 5 determining a second reference value according to the current information generated by each of the battery cells during the target time period;
- computing the actual state information of each of the battery cells according to the first reference value and the second reference value.

[0011] In one embodiment, the determining the to-be-optimized state of the group to which each of the battery cells belongs according to the actual state information of
10 each of the battery cells includes:

- determining group charge information of the group according to actual charge information of each battery cell contained in the group;
- determining group state information of the group according to actual state information of each battery cell contained in the group;
- 15 determining the to-be-optimized state of the group according to the group charge information, the group state information, a preset group charge threshold interval and a preset group state threshold interval.

[0012] In one embodiment, the group includes one of a container, a sub-system, a battery cluster; where the container includes at least one sub-system, the sub-system
20 includes at least one battery cluster, the battery cluster includes at least one battery cell;

- where the determining group charge information of the group according to the actual charge information of each battery cell contained in the group includes:
 - determining group charge information of the battery cluster according to actual charge information of the battery cell included in the battery cluster;
 - 25 determining group charge information of the sub-system according to the group charge information of the battery cluster included in the sub-system;
 - determining group charge information of the container according to the group charge information of the sub-system included in the container;
 - where the determining the group state information of the group according to

the actual state information of each battery cell contained in the group includes:

determining group state information of the battery cluster according to actual state information of the battery cell included in the battery cluster;

5 determining group state information of the sub-system according to the group state information of the battery cluster included in the sub-system;

determining group state information of the container according to the group state information of the sub-system included in the container.

[0013] In one embodiment, the to-be-optimized state includes a class of charge to be optimized and a class of state to be optimized;

10 the group charge threshold interval includes at least one of a container charge threshold interval, a sub-system charge threshold interval and a battery cluster charge threshold interval;

the group state threshold interval includes at least one of a container state threshold interval, a sub-system state threshold interval and a battery cluster state threshold interval;

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where the determining the to-be-optimized state of the group according to the group charge information, the group state information, the preset group charge threshold interval and the preset group state threshold interval includes:

determining the battery cluster, the sub-system, and the container to be of the class of charge to be optimized, when the group charge information of the battery cluster does not conform to the battery cluster charge threshold interval, the group charge information of the sub-system does not conform to the sub-system charge threshold interval, and the group charge information of the container does not conform to the container charge threshold interval;

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determining the battery cluster, the sub-system and the container to be of the class of state to be optimized, when the group state information of the battery cluster does not conform to the battery cluster state threshold interval, the group state information of the sub-system does not conform to the sub-system state threshold interval, and the group state information of the container does not conform to the

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container state threshold interval.

[0014] In one embodiment, the optimization instruction carries at least one of a charge optimization label and a state optimization label;

where the determining the target optimization group from the groups and
5 optimizing the battery cell in the target optimization group in response to the optimization instruction includes:

when the optimization instruction carries the charge optimization label,
taking a group of the class of charge to be optimized as the target optimization group
according to the charge optimization label, and recharging the battery cell in the target
10 optimization group;

when the optimization instruction carries the state optimization label, taking
a group of the class of state to be optimized as the target optimization group according
to the state optimization label, and replacing the battery cell in the target optimization
group;

15 when the optimization instruction carries the charge optimization label and
the state optimization label, taking a group of the class of charge to be optimized as the
target optimization group according to the charge optimization label and charging the
battery cell in the target optimization group, and taking a group of the class of state to
be optimized as the target optimization group according to the state optimization label
20 and replacing the battery cell in the target optimization group.

[0015] In a second aspect, the present application also provides an apparatus for
optimizing energy storage system, including:

an acquiring module, configured to acquire configuration information of
each of battery cells in a target station corresponding to a detection instruction in
25 response to the detection instruction;

a computing module, configured to compute actual state information of each
of the battery cells according to the configuration information;

a determining module, configured to determine a to-be-optimized state of a
group to which each of the battery cells belongs according to the actual state

information of each of the battery cells;

an optimizing module, configured to determine a target optimization group from groups and optimize the battery cell in the target optimization group in response to an optimization instruction.

5 **[0016]** In a third aspect, the present application also provides a computer device. The computer device includes a memory and a processor, the memory stores a computer program, and when the processor executes the computer program, the method for optimizing an energy storage system described in any of the above embodiments is implemented.

10 **[0017]** In a fourth aspect, the present application also provides a computer readable storage medium. A computer program is stored on the computer readable storage medium, and when the computer program is executed by a processor, the method for optimizing an energy storage system described in any of the above embodiments is implemented.

15 **[0018]** In a fifth aspect, the present application also provides a computer program product. The computer program product includes a computer program, when the computer program is executed by a processor, the method for optimizing an energy storage system described in any of the above embodiments is implemented.

20 **[0019]** According to the above method and apparatus for optimizing energy storage system, the device, the storage medium and the program product, accuracy of the judgment on the to-be-optimized state would be at the battery cell level, thus making it possible to perform an accurate judgment on the actual state of the battery in the energy storage system. In this way, a granularity of a judgment basis for a final determination of the to-be-optimized state becomes relatively smaller, a judgment result becomes
25 more accurate, so problems of the energy storage system can be found timely and effectively, and a better optimization effect can be achieved.

BRIEF DESCRIPTION OF DRAWINGS

[0020] The drawings herein are incorporated into and form part of the specification,

show embodiments that comply with the present application, and are used together with the specification to explain the rationale of the present application.

[0021] FIG. 1 is an application environment diagram of a method for optimizing an energy storage system in an embodiment.

5 **[0022]** FIG. 2 is a schematic flowchart of a method for optimizing an energy storage system in an embodiment.

[0023] FIG. 3 is a schematic flowchart of a method for optimizing an energy storage system in an embodiment.

10 **[0024]** FIG. 4 is a schematic flowchart of a method for optimizing an energy storage system in an embodiment.

[0025] FIG. 5 is a schematic flowchart of a method for optimizing an energy storage system in an embodiment.

[0026] FIG. 6 is a schematic flowchart of a method for optimizing an energy storage system in an embodiment.

15 **[0027]** FIG. 7 is a schematic flowchart of a method for optimizing an energy storage system in an embodiment;

[0028] FIG. 8 is a schematic flowchart of a method for optimizing an energy storage system in an embodiment.

20 **[0029]** FIG. 9 is a structural diagram of an apparatus for optimizing an energy storage system in an embodiment.

[0030] FIG. 10 is an internal structure diagram of a computer device in an embodiment.

25 **[0031]** Specific embodiments of the present application have been shown by the drawings above and will be described in more detail later. These drawings and textual descriptions are not intended in any way to limit the scope of the ideas presented in the present application, but rather to illustrate the concepts of the present application for those skilled in the art by reference to specific embodiments.

DESCRIPTION OF EMBODIMENTS

[0032] Illustrative embodiments will be illustrated in detail here, examples of which are shown in the attached drawings. Where the description below relates to drawings, the same numbers in different drawings represent the same or similar elements unless
5 otherwise indicated. Implementations described in the following exemplary embodiments do not represent all implementations consistent with the present application. Rather, they are merely examples of apparatus and methods that are consistent with aspects of the present application and as detailed in the attached claims.

[0033] The method for optimizing an energy storage system provided by an
10 embodiments of the present application can be applied to the application environment as shown in FIG. 1. A terminal 102 communicates with a server 104 over a network.

[0034] For example, the method for optimizing an energy storage system is applied to the terminal 102. When receiving a detection instruction, the terminal 102 acquires configuration information of each of battery cells in a target station corresponding to a
15 detection instruction from a data storage system of the server 104, then, computes actual state information of each of the battery cells according to the configuration information, and determines a to-be-optimized state of a group to which each of the battery cells belongs according to the actual state information of each of the battery cells. Finally, when receiving an optimization instruction, the terminal 102 determines a target
20 optimization group from groups and optimizes the battery cell in the target optimization group. Among them, the terminal 102 can be but not limited to a variety of personal computers, laptops, smart phones, tablets, Internet of Things devices and portable wearable devices, Internet of things devices can be smart speakers, smart TVs, intelligent air conditioners, intelligent vehicle-mounted devices and so on. Portable
25 wearable devices can be smart watches, smart bracelets, head-mounted devices, etc. Server 104 can be implemented as a standalone server or as a sever cluster consisting of multiple servers. The terminal 102 and the server 104 may be directly or indirectly connected via wired communication or wireless communication, such as connection through a network.

[0035] Another example is that the method for optimizing an energy storage system is applied to the server 104. When receiving a detection instruction, the terminal 102 sends the detection instruction to the server 104, and then the server 104 acquires, from a data storage system, configuration information of each of the battery cells in a target station corresponding to the detection instruction, and computes actual state information of each of the battery cells according to the configuration information, and determines a to-be-optimized state of a group to which each of the battery cells belongs according to the actual state information of each of the battery cells. Finally, when receiving an optimization instruction, the server 104 determines a target optimization group from groups and optimizes the battery cell in the target optimization group. It can be understood that the data storage system can be an independent storage device, or the data storage system can be located on the server 104, or the data storage system can be located on another terminal.

[0036] It should be noted that different network standards may be applicable for implementing network communication between the terminal 102 and the server 104, for example, the Global System of Mobile communication (GSM), Code Division Multiple Access (CDMA), Wideband Code Division Multiple Access (WCDMA), Time Division-Synchronous Code Division Multiple Access (TD-SCDMA), Long Term Evolution (LTE) systems and future 5G and other network standards. Optionally, the above communication system can be a system in the scenario of Ultra-Reliable and Low Latency Communications (URLLC) transmission in the 5G communication system.

[0037] Therefore, optionally, the base station can be a base transceiver station (BTS) and/or a base station controller in GSM or CDMA, or a NodeB (NB) in WCDMA and/or Radio Network Controller (RNC), which can also be an Evolutional NodeB (eNB or eNodeB) in LTE, or a relay station or access point, or a base station (gNB) in the future 5G network, which is not limited in the present application.

[0038] The terminal 102 may be a wireless terminal or a wired terminal. Wireless terminals can be devices that provide voice and/or other business data connectivity to users, handheld devices with wireless connectivity capabilities, or other processing

devices connected to wireless modems. A wireless terminal may communicate with one or more core network devices via a radio access network (RAN), and the wireless terminal may be a mobile terminal, such as a mobile telephone (or “cellular” telephone) and a computer with a mobile terminal, for example, it can be a portable, pocket, handheld, computer built-in, or vehicle-mounted mobile device that exchanges language and/or data with a wireless access network. For example, the wireless terminal can also be a personal communication service (PCS) telephone, a cordless telephone, a session initiation protocol (SIP) phones, a wireless local loop (WLL) stations, a personal digital assistant (PDA) and other devices. A wireless terminal can also be called a system, a subscriber unit, a subscriber station, a mobile station, a mobile, a remote station, a remote terminal, an access terminal, a user terminal, a user agent, a user device or user equipment, which is not limited herein. Optionally, the terminal device can also be a smart watch, a tablet computer and other devices.

[0039] In one embodiment, a method for optimizing an energy storage system is provided is illustrated, and in this embodiment, the method is applied to a terminal. It can be understood that the method can also be applied to a server, and can also be applied to a system including a terminal and a server, and is realized through the interaction between the terminal and server. As shown in FIG. 2, the method for optimizing the energy storage system includes:

Step 202, in response to a detection instruction, acquiring configuration information of each of battery cells in a target station corresponding to the detection instruction.

[0040] The detection instruction refers to an instruction for detecting an actual state of a battery cell in a station. As an example, the detection instruction can be issued by the staff of the station through a fixed component on a human-computer interface of the terminal, or it can be automatically generated by the terminal or server according to a pre-set generation frequency. The fixed component can be a pre-built page or a small program.

[0041] The method for optimizing the energy storage system in this embodiment

applies to the energy storage system, the energy storage system refers to a system capable of converting electrical energy into other forms of energy and then converting the same into electrical energy when needed. Such a system can be used to store electrical energy to balance the imbalance between supply and demand, cope with power grid fluctuations, and improve energy utilization efficiency.

[0042] The energy storage system can include multiple stations, the multiple stations can be distributed at different locations to achieve collaborative operation through interconnection, improve the overall energy storage capacity and flexibility.

[0043] The detection instruction can carry an object label, and the terminal can determine a corresponding station in the energy storage system as the target station according to the object label carried in the detection instruction, and further acquire the configuration information of all battery cells contained in the target station. The object label can be composed of at least one of letter(s), character(s), or number(s), such as the name and number of the station. The object label is used to uniquely refer to the station. In the embodiments, a mapping relationship between object labels and stations, as well as a mapping relationship between stations and all battery cells included, may be pre-stored in the server.

[0044] The configuration information indicates the actual state of the battery cell. For example, the configuration information can include a model, a capacity, an operating voltage, an operating current, an operating power, an operating temperature, a state of charge (SOC), and a state of health (SOH) of the battery cell.

[0045] Among them, the configuration information can be stored in the data storage system of the server, and the server can collect the actual state of each of the battery cells according to a preset collection frequency and overwrite the storage.

[0046] Step 204, computing actual state information of each of the battery cells according to the configuration information.

[0047] The actual state information can include, for example, information about SOH of the battery cell.

[0048] Step 206, determining a to-be-optimized state of a group to which each of

the battery cells belongs according to the actual state information of each of the battery cells.

5 **[0049]** The to-be-optimized state of the group refers to an optimization option that needs to be acted upon a current group. In order to ensure the normal operation of the energy storage system, for the group, it is not only necessary to ensure that there is no equipment failure of the battery cell(s), but also to ensure that the SOC of the battery cell(s) is sufficient. Therefore, the to-be-optimized state of the group may include a state in which the battery cell(s) in the group needs to be replaced and the state in which the battery cell(s) in the group needs to be recharged.

10 **[0050]** Step 208, in response to an optimization instruction, determining a target optimization group from groups and optimizing battery cell(s) in the target optimization group.

15 **[0051]** The optimization instruction refers to an instruction to optimize battery cell(s) in a station. As an example, the optimization instruction can be issued by the staff of the station through a fixed component on the human-computer interface of the terminal, or it can be automatically generated by the terminal or server according to a pre-set generation frequency.

20 **[0052]** The optimization instruction can carry an optimization label, and the terminal can determine a corresponding group as the target optimization group according to the optimization label carried in the optimization instruction, and further optimize all battery cells contained in the target optimization group. The optimization label can be composed of at least one of letter(s), character(s), or number(s), for example, the name and number of the station, and the to-be-optimized state of the group. The optimization label is used to uniquely refer to the group. In the embodiments, the mapping relationship between optimization labels and groups may be pre-stored in the server.

25 **[0053]** As an example, after determining the target optimization group, the terminal can optimize the battery cell(s) in the target optimization group according to a to-be-optimized state of the target optimization group. When the to-be-optimized state of the

target optimization group indicates that the battery cell(s) in the current group needs to be replaced, the terminal can generate prompt information to remind the staff to replace the battery cell(s), or, the terminal can automatically generate a control signal and send it to a robot arm which is arranged in advance in the station and serves the target optimization group, so as to control the robot arm to replace the battery cell(s) in the target optimization group. When the to-be-optimized state of the target optimization group indicates that the battery cell(s) in the current group needs to be recharged, the terminal can generate another prompt information to remind the staff to recharge the battery cell(s), or the terminal can automatically generate another control signal and send it to a standby power supply in the target station to control the standby power supply to recharge the battery cell(s) in the target optimization group.

[0054] In the above method for optimizing the energy storage system, the terminal can acquire the configuration information of each of the battery cells in the target station after receiving the detection instruction, and use the configuration information to compute the actual state information, and determine the to-be-optimized state of the group to which the battery cell belongs, so accuracy of the judgment on the to-be-optimized state would be at the battery cell level, thus making it possible to perform an accurate judgment on the actual state of the battery in the energy storage system. In this way, a granularity of a judgment basis for a final determination of the to-be-optimized state becomes relatively smaller, a judgment result becomes more accurate, so problems of the energy storage system can be found timely and effectively, and a better optimization effect can be achieved.

[0055] In some optional embodiments, as shown in FIG. 3, before Step 204, the method further includes:

Step 203a, screening out abnormal data from the configuration information according to a preset information threshold;

Step 203b, cleaning the abnormal data, and sorting rest configuration information to obtain processed configuration information;

Step 204 includes:

Step 204a, computing the actual state information of each of the battery cells according to the processed configuration information.

5 [0056] The information threshold refers to at least one threshold or threshold range corresponding to the configuration information. For example, when the configuration information includes the operating voltage, operating current, operating power, operating temperature, the information threshold can include an operating voltage threshold, operating current threshold, operating power threshold, operating temperature threshold.

10 [0057] The terminal can match configuration data with the corresponding threshold range, and screen out configuration data that exceeds the corresponding threshold range as abnormal data. In Step 204, the actual state information of each of the battery cells is computed based on the rest configuration information after the abnormal data is removed and sorting is performed.

15 [0058] In this embodiment, by presetting the information threshold, rapid screening and processing of abnormal data in the configuration information can be realized, thus improving the efficiency of data processing, and ensuring the accuracy of the configuration information.

[0059] As shown in FIG. 4, in some optional embodiments, the detection instruction carries a time period label;

20 Step 202 includes:

Step 2022, determining a target time period according to the time period label;

Step 2024, acquiring the configuration information of each of the battery cells during the target time period.

25 [0060] The time period label can be composed of at least one of letter(s), character(s), or number(s). The time period label is used to uniquely refer to a time period. In this embodiment, a mapping relationship between the time period label and the time period is pre-stored in the server.

[0061] The terminal can determine the target time period according to the time

period label carried in the detection instruction, and acquire the configuration information generated by the battery cells in the target station during the target time period, so as to realize the state judgment and optimization processing of the battery cells within a fixed time period.

- 5 **[0062]** As shown in FIG. 5, in some optional embodiments, the configuration information carries a generation time label;

Step 203b includes:

Step 2032, cleaning and filling the abnormal data to obtain cleaned configuration information;

- 10 Step 2034, determining a generation time of the cleaned configuration information according to the generation time label carried in the cleaned configuration information, and sorting the cleaned configuration information according to the generation time to obtain the processed configuration information.

- [0063]** The generation time label can be composed of at least one of letter(s), character(s), or number(s). The time period label is used to uniquely refer to a generation time corresponding to the configuration information of the battery cell. In this embodiment, a mapping relationship between generation time labels and specific time is pre-stored in the server.
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- [0064]** Data filling refers to a method of replacing missing or empty values with other numeric values. Common data filling methods include: constant filling (replacing a missing value with a fixed value (such as 0, an average, a median, etc.)); forward filling (filling the missing value with a value before the missing value); backward filling (filling the missing value with a value after the missing value); interpolation filling (filling the missing value by using an interpolation method (such as linear interpolation, polynomial interpolation, etc.) according to values of known data points); random filling (filling the missing value with a randomly generated value); model filling (predicting and filling the missing value by using a machine learning model (such as regression, random forests, etc.)), etc.
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- [0065]** In some optional embodiments, as shown in FIG. 6, before Step 204, the

method further includes:

Step 203c, determining actual charge information of each of the battery cells at a beginning of the target time period and actual charge information of each of the battery cells at an ending of the target time period according to the configuration
5 information;

Step 204 includes:

Step 204b, computing the actual state information of each of the battery cells according to the configuration information, the actual charge information of each of the battery cells at the beginning of the target time period and the actual charge information
10 of each of the battery cells at the ending of the target time period.

[0066] The actual charge information can refer to the SOC information.

[0067] In some optional embodiments, as shown in FIG. 7, the configuration information includes current information generated by each of the battery cells during the target time period;

15 Step 204b includes:

Step 2042, determining a first reference value according to a difference value between the actual charge information of each of the battery cells at the beginning of the target time period and the actual charge information of each of the battery cells at the ending of the target time period;

20 Step 2044, determining a second reference value according to the current information generated by each of the battery cells during the target time period;

Step 2046, computing the actual state information of each of the battery cells according to the first reference value and the second reference value.

[0068] As an example, the quotient of the second reference value and the first
25 reference value can be used as the actual state information of the battery cell.

[0069] Step 204b can be computed using the following formula to obtain the actual state information:

$$SOH = \frac{\sum(I * t_{diff})}{SOC_{n1} - SOC_{n2}}$$

where SOC_{n1} represents the actual charge information at the beginning of the target time period, SOC_{n2} represents the actual charge information at the ending of the target time period, $SOC_{n1} - SOC_{n2}$ represents the first reference value, I represents the current information generated by the battery cell in the target time period, and t_{diff} represents the first-order difference of time in the target time period, and SOH represents the actual state information.

[0070] In some optional embodiments, as shown in FIG. 8, Step 206 includes:

Step 2062, determining group charge information of the group according to actual charge information of each battery cell contained in the group;

10 Step 2064, determining group state information of the group according to actual state information of each battery cell contained in the group;

Step 2066, determining the to-be-optimized state of the group according to the group charge information, the group state information, a preset group charge threshold interval and a preset group state threshold interval.

15 **[0071]** In this embodiment, the terminal can determine the group charge information of the group according to the actual charge information of battery cell(s) contained in the group, and the group state information of the group according to the actual state information of the battery cell(s) contained in the group.

[0072] As an example, the group includes one of a container, a sub-system, a battery cluster; where the container includes at least one sub-system, the sub-system includes at least one battery cluster, the battery cluster includes at least one battery cell;

20 in Step 2062, determining group charge information of the battery cluster according to actual charge information of the battery cell included in the battery cluster; determining group charge information of the sub-system according to the group charge information of the battery cluster included in the sub-system; determining group charge information of the container according to the group charge information of the sub-system included in the container;

in Step 2064, determining group state information of the battery cluster according to actual state information of the battery cell included in the battery cluster;

determining group state information of the sub-system according to the group state information of the battery cluster included in the sub-system; determining group state information of the container according to the group state information of the sub-system included in the container.

- 5 **[0073]** Specifically, the to-be-optimized state includes a class of charge to be optimized and a class of state to be optimized; the group charge threshold interval includes at least one of a container charge threshold interval, a sub-system charge threshold interval and a battery cluster charge threshold interval; the group state threshold interval includes at least one of a container state threshold interval, a sub-
10 system state threshold interval and a battery cluster state threshold interval. Step 2066 includes the following steps: determining the battery cluster, the sub-system, and the container to be of the class of charge to be optimized, when the group charge information of the battery cluster does not conform to the battery cluster charge threshold interval, the group charge information of the sub-system does not conform to
15 the sub-system charge threshold interval, and the group charge information of the container does not conform to the container charge threshold interval; determining the battery cluster, the sub-system and the container to be of the class of state to be optimized, when the group state information of the battery cluster does not conform to the battery cluster state threshold interval, the group state information of the sub-system
20 does not conform to the sub-system state threshold interval, and the group state information of the container does not conform to the container state threshold interval.

[0074] In some optional embodiments, the optimization instruction carries at least one of a charge optimization label and a state optimization label;

Step 208 includes:

- 25 when the optimization instruction carries the charge optimization label, taking a group of the class of charge to be optimized as the target optimization group according to the charge optimization label, and recharging the battery cell in the target optimization group;

when the optimization instruction carries the state optimization label, taking

a group of the class of state to be optimized as the target optimization group according to the state optimization label, and replacing the battery cell in the target optimization group;

when the optimization instruction carries the charge optimization label and
5 the state optimization label, taking a group of the class of charge to be optimized as the target optimization group according to the charge optimization label and charging the battery cell in the target optimization group, and taking a group of the class of state to be optimized as the target optimization group according to the state optimization label and replacing the battery cell in the target optimization group.

10 **[0075]** The charge optimization label can be composed of at least one of letters, character(s), or number(s). The charge optimization label is used to uniquely refer to the group charge information of the class of charge to be optimized. The state optimization label can be composed of at least one of letters, character(s), or number(s). The state optimization label is used to uniquely refer to the group state information of
15 the class of state to be optimized.

[0076] According to an optimization type corresponding to the optimization instruction, the terminal can determine, from multiple groups, the group whose to-be-optimized state matches the optimization instruction as the target optimization group.

[0077] As an example, the terminal can also set priorities for the battery cluster,
20 sub-system, and container in advance, as from high to low. When the optimization instruction matches to-be-optimized states of a battery cluster, a sub-system, and a container at the same time, the battery cluster is contained in the sub-system, and the sub-system is contained in the container, the terminal takes the battery cluster as the target optimization group.

25 **[0078]** In one embodiment, the optimization instruction may also carry a level label, which may be composed of at least one of the letters, character(s), or number(s). The level label is used to uniquely refer to the level of the group, that is, one of battery cluster, sub-system, or container. Upon receiving the optimization instruction, the terminal may first screen out group(s) that does not conform to the level label. Then,

the terminal uses the charge optimization label and/or the state optimization label carried in the optimization instruction to find, among remaining groups, a group corresponding to the optimization instruction as the target optimization group.

[0079] According to the above method for optimizing the energy storage system,

5 the configuration information at the battery cell level is used to compute the actual state information and actual charge information of the battery cell, and then the to-be-optimized state of the battery cluster to which the battery cell belongs, the to-be-optimized state of the sub-system to which the battery cluster belongs, and the to-be-optimized state of the container to which the sub-system belongs can be determined, so
10 accuracy of the judgment on the to-be-optimized state would be at the battery cell level, thus making it possible to perform an accurate judgment on the actual state of the battery in the energy storage system. In this way, a granularity of a judgment basis for a final determination of the to-be-optimized state becomes relatively smaller, a judgment result becomes more accurate, so problems of the energy storage system can
15 be found timely and effectively, and a better optimization effect can be achieved.

[0080] It should be understood that, although the steps in the flowcharts involved in the embodiments above are shown sequentially as indicated by the arrows, they are not necessarily performed sequentially in the order indicated by the arrows. Unless explicitly stated in this article, there is no strict order in which these steps can be
20 executed, and these steps can be executed in other orders. Moreover, at least part of the steps in the flowcharts involved in the above embodiments may include multiple steps or stages, which are not necessarily completed at the same time, but may be executed at different times, and the execution sequence of these steps or stages is not necessarily sequential. Instead, it can be performed alternately or interchangeably with other steps
25 or at least parts of steps or stages within other steps.

[0081] Based on the same idea, an embodiment of the present application also provides an apparatus for optimizing an energy storage system for implementing the method for optimizing an energy storage system mentioned above. A realization scheme to solve the problem provided by the apparatus for optimizing the energy storage system

is similar to realization schemes recorded in the above methods for optimizing the energy storage system, so for specific description of one or more apparatus embodiments provided below, reference can be made to the above description of the methods for optimizing the energy storage system, and will not be repeated here.

5 **[0082]** In one embodiment, shown in FIG. 9, an apparatus 900 for optimizing an energy storage system is provided, including:

 an acquiring module 902, configured to acquire configuration information of each of battery cells in a target station corresponding to a detection instruction in response to the detection instruction;

10 a computing module 904, configured to compute actual state information of each of the battery cells according to the configuration information;

 a determining module 906, configured to determine a to-be-optimized state of a group to which each of the battery cells belongs according to the actual state information of each of the battery cells;

15 an optimizing module 908, configured to determine a target optimization group from groups and optimize a battery cell in the target optimization group in response to an optimization instruction.

[0083] In some optional embodiments, the computing module 904 is also configured to:

20 screen out abnormal data from the configuration information according to a preset information threshold;

 clean the abnormal data, and sort the rest configuration information to obtain processed configuration information;

 compute the actual state information of each of the battery cells according
25 to the processed configuration information.

[0084] In some optional embodiments, the detection instruction carries a time period label;

 the acquiring module 902 is further configured to:

 determine a target time period according to the time period label;

obtain the configuration information of each of the battery cells during the target time period.

[0085] In some optional embodiments, the configuration information carries a generation time label;

5 the computing module 904 is further configured to:
 clean and fill the abnormal data to obtain cleaned configuration information;
 determine a generation time of the cleaned configuration information
 according to the generation time label carried in the cleaned configuration information,
 and sort the cleaned configuration information according to the generation time to
10 obtain the processed configuration information.

[0086] In some optional embodiments, the computing module 904 is further configured to:

 determine actual charge information of each of the battery cells at a
 beginning of the target time period and actual charge information of each of the battery
15 cells at an ending of the target time period according to the configuration information;
 compute the actual state information of each of the battery cells according
 to the configuration information, the actual charge information of each of the battery
 cells at the beginning of the target time period and the actual charge information of each
 of the battery cells at the ending of the target time period.

20 **[0087]** In some optional embodiments, the configuration information includes
 current information generated by each of the battery cells during the target time period;

 the computing module 904 is further configured to:

 determine a first reference value according to a difference value between the
 actual charge information of each of the battery cells at the beginning of the target time
25 period and the actual charge information of each of the battery cells at the ending of the
 target time period;

 determine a second reference value according to the current information
 generated by each of the battery cells during the target time period;

 compute the actual state information of each of the battery cells according

to the first reference value and the second reference value.

[0088] In some optional embodiments, the determining module 906 is further configured to:

5 determine group charge information of the group according to actual charge information of each battery cell contained in the group;

determine group state information of the group according to actual state information of each battery cell contained in the group;

10 determine the to-be-optimized state of the group according to the group charge information, the group state information, a preset group charge threshold interval and a preset group state threshold interval.

[0089] In some optional embodiments, the group includes one of a container, a sub-system, a battery cluster; where the container includes at least one sub-system, the sub-system includes at least one battery cluster, the battery cluster includes at least one battery cell;

15 the determining module 906 is also configured to:

determine group charge information of the battery cluster according to actual charge information of the battery cell included in the battery cluster;

determine group charge information of the sub-system according to the group charge information of the battery cluster included in the sub-system;

20 determine group charge information of the container according to the group charge information of the sub-system included in the container;

determine group state information of the battery cluster according to actual state information of the battery cell included in the battery cluster;

25 determine group state information of the sub-system according to the group state information of the battery cluster included in the sub-system;

determine group state information of the container according to the group state information of the sub-system included in the container.

[0090] In some optional embodiments, the to-be-optimized state includes a class of charge to be optimized and a class of state to be optimized;

the group charge threshold interval includes at least one of a container charge threshold interval, a sub-system charge threshold interval and a battery cluster charge threshold interval;

the group state threshold interval includes at least one of a container state threshold interval, a sub-system state threshold interval and a battery cluster state threshold interval;

the determining module 906 is also configured to:

determine the battery cluster, the sub-system, and the container to be of the class of charge to be optimized, when the group charge information of the battery cluster does not conform to the battery cluster charge threshold interval, the group charge information of the sub-system does not conform to the sub-system charge threshold interval, and the group charge information of the container does not conform to the container charge threshold interval;

determine the battery cluster, the sub-system and the container to be of the class of state to be optimized, when the group state information of the battery cluster does not conform to the battery cluster state threshold interval, the group state information of the sub-system does not conform to the sub-system state threshold interval, and the group state information of the container does not conform to the container state threshold interval.

[0091] In some optional embodiments, the optimization instruction carries at least one of a charge optimization label and a state optimization label;

the optimizing module 908 is also configured to:

when the optimization instruction carries the charge optimization label, take a group of the class of charge to be optimized as the target optimization group according to the charge optimization label, and recharge the battery cell in the target optimization group;

when the optimization instruction carries the state optimization label, take a group of the class of state to be optimized as the target optimization group according to the state optimization label, and replace the battery cell in the target optimization group;

when the optimization instruction carries the charge optimization label and the state optimization label, take a group of the class of charge to be optimized as the target optimization group according to the charge optimization label and recharge the battery cell in the target optimization group, and take a group of the class of state to be optimized as the target optimization group according to the state optimization label, and replace the battery cell in the target optimization group.

[0092] Each module in the above apparatus can be implemented in whole or in part by software, hardware and their combination. The above modules can be embedded in or independent of a processor in a computer device in a hardware form, and can also be stored in a software form in a memory of the computer device, so that the processor can call and perform the corresponding operations of the above modules.

[0093] In one embodiment, a computer device is provided, which may be a terminal, the internal structure diagram of which may be shown in FIG. 10. The computer device includes a processor, a memory, an input/output interface, a communication interface, a display unit and an input apparatus. The processor, memory and input/output interface are connected through a system bus, and the communication interface, display unit and input apparatus are connected to the system bus through the input/output interface. Among them, the processor of the computer device is used to provide computing and control capabilities. The memory of the computer device includes a non-volatile storage medium and an internal memory. The non-volatile storage medium stores an operating system and a computer program. The internal memory provides an environment for the operation of operating systems and computer programs in the non-volatile storage medium. The input/output interface of the computer device is used to exchange information between the processor and external devices. The communication interface of the computer device is used for wired or wireless communication with external terminals, the wireless communication can be implemented via WIFI, mobile cellular networks, near Field communication (NFC), or other technologies. The computer program is executed by the processor to implement a method for optimizing an energy storage system. The display unit of the computer device is used to form a visually

visible picture, which can be a display screen, a projection apparatus or a virtual reality imaging apparatus. The display screen can be a liquid crystal display screen or electronic ink display screen, and the input apparatus of the computer device can be a touch layer covered on the display screen, or a key, trackball or trackpad set on a housing of the computer device, or an external keyboard, trackpad or mouse.

[0094] It can be understood by those skilled in the art that the structure shown in FIG. 10 is only a block diagram of a part of the structure related to the present application scheme and does not constitute a limitation of the computer device to which schemes of the present application are applied. Specific computer device may include more or fewer parts than those shown in the figure, or some parts may be combined, or parts may be arranged in different manners.

[0095] In one embodiment, a computer readable storage medium is provided, a computer program is stored thereon, and when the computer program is executed by a processor, each step of the above method for optimizing the energy storage system is implemented.

[0096] In one embodiment, a computer program product is provided, the computer program product includes a computer program, and when the computer program product is executed by a processor, each step of the above method for optimizing an energy storage system is implemented.

[0097] Those with ordinary skill in the field may understand that all or part of the processes of implementing the embodiments of the above methods can be completed by instructing the relevant hardware through a computer program. The computer program may be stored in a non-volatile computer readable storage medium. When the computer program is executed, processes such as those of the embodiments of the above methods may be included. Any reference to memory, database or other medium used in the embodiments provided by the present application may include at least one of a non-volatile and a volatile memory. The non-volatile memory may include a read only memory (ROM), a magnetic tape, a floppy disk, a flash memory, an optical memory, a high-density embedded non-volatile memory, a resistive memory (ReRAM), a

magnetoresistive random access memory (MRAM), a ferroelectric random access memory (FRAM), a phase change memory (PCM), a graphene memory, etc. The volatile memory can include a random access memory (RAM) or an external cache memory. As an illustration rather than a limitation, RAM can come in many forms, such
5 as a static random access memory (SRAM) or a dynamic random access memory (DRAM). The databases referred to in each embodiment provided by the present application may include at least one of relational and non-relational databases. Non-relational databases may include, but not limited to, blockchain-based distributed databases. The processors involved in the embodiments provided by the present
10 application may be general purpose processors, central processing processors, graphics processors, digital signal processors, programmable logics, data processing logics based on quantum computing, etc., but are not limited thereto.

[0098] The technical features of the above embodiments may be combined at will. For the sake of conciseness of description, not all possible combinations of the technical
15 features in the above embodiments are described. However, as long as there is no contradiction in the combination of these technical features, they should be considered as falling within the scope of this specification.

[0099] In the above embodiments, only several implementations of the present application are described, and their descriptions are more specific and detailed, but they
20 cannot be construed as limiting the scope of the present application. It should be noted that for those of ordinary skill in the field, without deviating from the concept of the present application, a number of deformation and improvement can be made, which are within the scope of protection of the present application. Therefore, the scope of protection of the present application shall be governed by the attached claims.

CLAIMS

1. A method for optimizing an energy storage system, comprising:
 - in response to a detection instruction, acquiring configuration information of each of battery cells in a target station corresponding to the detection instruction;
 - 5 computing actual state information of each of the battery cells according to the configuration information;
 - determining a to-be-optimized state of a group to which each of the battery cells belongs according to the actual state information of each of the battery cells;
 - in response to an optimization instruction, determining a target optimization group
 - 10 from groups and optimizing a battery cell in the target optimization group.
2. The method according to claim 1, before computing the actual state information of each of the battery cells according to the configuration information, further comprising:
 - screening out abnormal data from the configuration information according to a
 - 15 preset information threshold;
 - cleaning the abnormal data, and sorting rest configuration information to obtain processed configuration information;
 - wherein the computing the actual state information of each of the battery cells according to the configuration information comprises:
 - 20 computing the actual state information of each of the battery cells according to the processed configuration information.
3. The method according to claim 2, wherein the detection instruction carries a time period label;
 - wherein the acquiring configuration information of each of the battery cells in the
 - 25 target station corresponding to the detection instruction comprises:
 - determining a target time period according to the time period label;
 - acquiring the configuration information of each of the battery cells during the target time period.

4. The method according to claim 3, wherein the configuration information carries a generation time label;

wherein the cleaning the abnormal data, and sorting the rest configuration information to obtain the processed configuration information comprises:

5 cleaning and filling the abnormal data to obtain cleaned configuration information;
determining a generation time of the cleaned configuration information according to the generation time label carried in the cleaned configuration information, and sorting the cleaned configuration information according to the generation time to obtain the processed configuration information.

10 5. The method according to claim 3, before computing the actual state information of each of the battery cells according to the configuration information, further comprising:

determining actual charge information of each of the battery cells at a beginning of the target time period and actual charge information of each of the battery cells at an
15 ending of the target time period according to the configuration information;

wherein the computing the actual state information of each of the battery cells according to the configuration information comprises:

computing the actual state information of each of the battery cells according to the configuration information, the actual charge information of each of the battery cells at
20 the beginning of the target time period and the actual charge information of each of the battery cells at the ending of the target time period.

6. The method according to claim 5, wherein the configuration information comprises current information generated by each of the battery cells during the target time period;

25 wherein the computing the actual state information of each of the battery cells according to the configuration information, the actual charge information of each of the battery cells at the beginning of the target time period and the actual charge information of each of the battery cells at the ending of the target time period comprises:

determining a first reference value according to a difference value between the

actual charge information of each of the battery cells at the beginning of the target time period and the actual charge information of each of the battery cells at the ending of the target time period;

determining a second reference value according to the current information
5 generated by each of the battery cells during the target time period;

computing the actual state information of each of the battery cells according to the first reference value and the second reference value.

7. The method according to claim 5, wherein the determining the to-be-optimized state of the group to which each of the battery cells belongs according to the actual state
10 information of each of the battery cells comprises:

determining group charge information of the group according to actual charge information of each battery cell contained in the group;

determining group state information of the group according to actual state information of each battery cell contained in the group;

15 determining the to-be-optimized state of the group according to the group charge information, the group state information, a preset group charge threshold interval and a preset group state threshold interval.

8. The method according to claim 7, wherein the group comprises one of a container, a sub-system, a battery cluster; wherein the container comprises at least one
20 sub-system, the sub-system comprises at least one battery cluster, and the battery cluster comprises at least one battery cell;

wherein the determining the group charge information of the group according to the actual charge information of each battery cell contained in the group comprises:

determining group charge information of the battery cluster according to actual
25 charge information of the battery cell comprised in the battery cluster;

determining group charge information of the sub-system according to the group charge information of the battery cluster comprised in the sub-system;

determining group charge information of the container according to the group charge information of the sub-system comprised in the container;

wherein the determining the group state information of the group according to the actual state information of each battery cell contained in the group comprises:

determining group state information of the battery cluster according to actual state information of the battery cell comprised in the battery cluster;

5 determining group state information of the sub-system according to the group state information of the battery cluster comprised in the sub-system;

determining group state information of the container according to the group state information of the sub-system comprised in the container.

9. The method according to claim 8, wherein the to-be-optimized state comprises
10 a class of charge to be optimized and a class of state to be optimized;

the group charge threshold interval comprises at least one of a container charge threshold interval, a sub-system charge threshold interval and a battery cluster charge threshold interval;

15 the group state threshold interval comprises at least one of a container state threshold interval, a sub-system state threshold interval and a battery cluster state threshold interval;

wherein the determining the to-be-optimized state of the group according to the group charge information, the group state information, the preset group charge threshold interval and the preset group state threshold interval comprises:

20 determining the battery cluster, the sub-system, and the container to be of the class of charge to be optimized, when the group charge information of the battery cluster does not conform to the battery cluster charge threshold interval, the group charge information of the sub-system does not conform to the sub-system charge threshold interval, and the group charge information of the container does not conform to the
25 container charge threshold interval;

determining the battery cluster, the sub-system and the container to be of the class of state to be optimized, when the group state information of the battery cluster does not conform to the battery cluster state threshold interval, the group state information of the sub-system does not conform to the sub-system state threshold interval, and the

group state information of the container does not conform to the container state threshold interval.

10. The method according to claim 9, wherein the optimization instruction carries at least one of a charge optimization label and a state optimization label;

5 wherein the in response to the optimization instruction, determining the target optimization group from the groups and optimizing the battery cell in the target optimization group comprises:

10 when the optimization instruction carries the charge optimization label, taking a group of the class of charge to be optimized as the target optimization group according to the charge optimization label, and recharging the battery cell in the target optimization group;

15 when the optimization instruction carries the state optimization label, taking a group of the class of state to be optimized as the target optimization group according to the state optimization label, and replacing the battery cell in the target optimization group;

20 when the optimization instruction carries the charge optimization label and the state optimization label, taking a group of the class of charge to be optimized as the target optimization group according to the charge optimization label and charging the battery cell in the target optimization group, and taking a group of the class of state to be optimized as the target optimization group according to the state optimization label and replacing the battery cell in the target optimization group.

11. An apparatus for optimizing an energy storage system, comprising:

25 an acquiring module, configured to acquire configuration information of each of battery cells in a target station corresponding to a detection instruction in response to the detection instruction;

 a computing module, configured to compute actual state information of each of the battery cells according to the configuration information;

 a determining module, configured to determine a to-be-optimized state of a group to which each of the battery cells belongs according to the actual state information of

each of the battery cells;

an optimizing module, configured to determine a target optimization group from groups and optimize a battery cell in the target optimization group in response to an optimization instruction.

5 12. A computer device comprising a memory and a processor, wherein the memory stores a computer program, and when the processor executes the computer program, steps of the method for optimizing an energy storage system according to any of claims 1 to 10 are implemented.

10 13. A computer readable storage medium, wherein a computer program is stored on the computer readable storage medium, and when the computer program is executed by a processor, steps of the method for optimizing an energy storage system according to any of claims 1 to 10 are implemented.

15 14. A computer program product comprising a computer program, wherein when the computer program is executed by a processor, steps of the method for optimizing an energy storage system according to any of claims 1 to 10 are implemented.