Conflict Evading Algorithm Using Optimistic Concurrency Mechanism to Resolve Conflicts between Transactions

Dr.Kamalakannan Machap
School of Technology
Asia Specific University,
Malaysia
Email: dr.kamalakannan@apu.edu.my

Abstract

The optimistic concurrency mechanism is used for the transactional memory. When a transaction conflict occurs, the competition management strategy will be adopted to decide which transaction to be executed continuously and which to be revoked for re-execution. When the conflict between transactions in the system is small, the good performance can be maintained well with this method. However, in extreme cases with frequent transactional conflicts, then numerous system resources will be consumed for conflict detection and competition management operation. Conflict evading is to predict the transaction conflict situation and avoid the entering of transactions that may have a large number of conflicts into the system. Conflict evading is new concept with little literature study by the current academic circle. With the increasingly serious problem of urban environmental pollution and the outbreak of energy crisis, the exhaust pollution of traditional fuel vehicles is gradually paid attention to by the public. Pure electric vehicles, hybrid electric vehicles and increase electric vehicles with low pollution and low consumption become the most potential substitutes for the traditional fuel vehicles at present, while the power battery and its management system of electric vehicles, the drive motor and electric control become the key to its development. Battery is the energy storage facility which is widely used in all walks of life. It is an indispensable foundation to ensure the safe operation of all kinds of important electricity load. The ups unit mainly uses the valve regulated lead acid battery as the energy storage device, which constitutes the uninterruptible power supply system. The valve regulated lead acid battery has the advantages of mature technology, complete product specifications, etc., but in the whole ups power supply system, the purchase cost, floor area, environmental temperature requirements, operating life, daily maintenance difficulty and workload of the battery group are beyond the ups unit.

Keywords: State of charge estimation, Multicore PC, transactional memory, MAP log sheet, conflict evading algorithm.

1. Introduction

When a transaction starts, it will be allocated with an ID by the underlying transaction manager, and the instruction address at this time will be recorded, thus avoiding the rollback of the transaction to the initial position for re-execution in case of conflicts. The execution process of a transaction can be divided into two possibilities, namely, success and failure. A successful implementation process is:

Corresponding Author : Dr Kamalakannan Machap
Funding information : There is no fun information
Paper Received on : 28/09/2021
Paper Accepted on : 20/12/2021

transaction starts ---> implementation phase ---> transaction commits ---> end; and the failed implementation process is: transaction starts ---> implementation phase ---> transaction rollback [1]. The read-write consistency check is conducted during the execution of the transaction. In case of conflicts about the read-write address, a transaction will be selected by the competition manager for rollback [2]. In recent years, the technical development of valve regulated lead acid battery is relatively slow, and no significant technological breakthrough has been achieved. The lithium battery technology, represented by phosphorus lithium battery, on the basis of many years of research and practice, constantly emerging related technology breakthrough innovation, application scope to step by step expansion, is considered as a great development potential, the future is expected to replace the new generation of lead-acid battery power storage device.

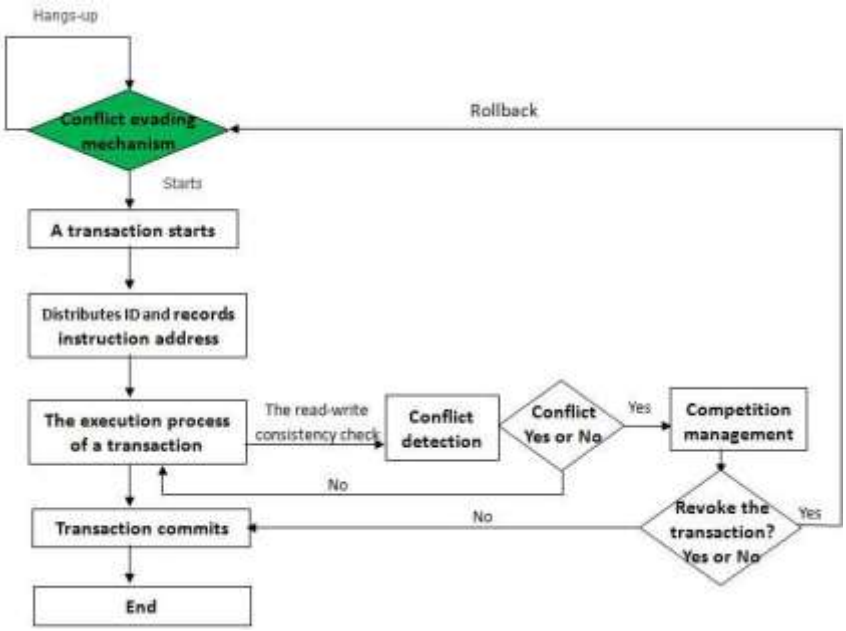

Fig 1 Addition of the conflict evading mechanism in life cycle of transaction memory

The transaction execution process adopting the conflict evading mechanism is shown in **Fig 1**. Unlike the traditional transaction execution process, the beginning of the transaction is no longer restricted; instead, a conflict prediction has to be carried out before the re-execution of the rollback transaction through competition management before the start of new transactions each time. If it is judged that the possibility of the occurrence of the transaction conflict is large, and then the transaction will be suspended, otherwise, it will be executed. How to predict the likelihood of conflicts is the key to the algorithm. The read-write address set when the conflict occurs can be recorded in operation as the recording to historical conflict situations, and then it will be saved to the local private log sheet H (history). Before the transaction starts, the element set of the transaction C (current) will be compared to H. If repetition of elements in the set C and H reaches a threshold value, the transaction will be suspended

2. Literature Survey

The performance of power battery of electric vehicle is affected by many factors, including temperature, charge / discharge cycle times, charge / discharge ratio and aging degree of electric pool. The accurate estimation of the state of charge (SOC) of lithium battery is the basis of quantifying the above factors, estimating the health state (SOH), and the sexual energy state (SOF) [2]. The SOC definition of the monomer battery used in this paper is the ratio ξ SOC of the battery surplus capacity and the rated capacity. **Fig 2** shows actors of the internal state affecting on the battery life.

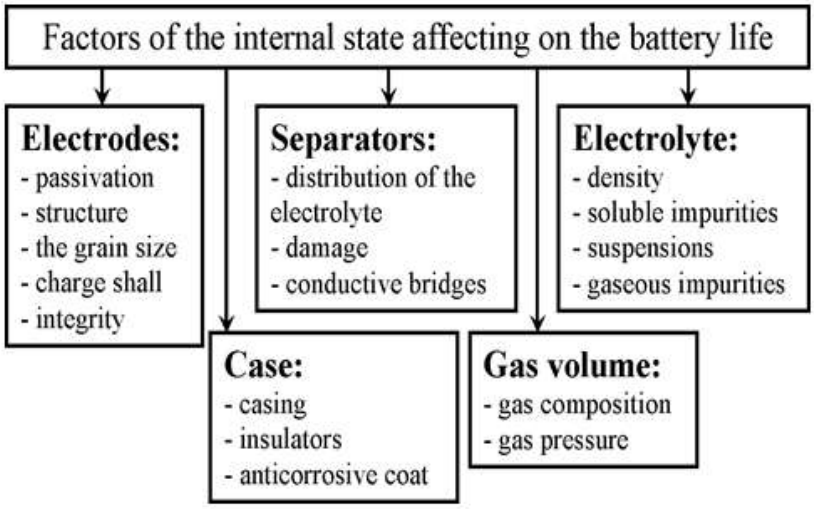

Fig 2 Factors of the internal state affecting on the battery life

At present, there are many methods to estimate the SOC of lithium battery, the simplest and most widely used [4]., but because of measurement error and noise, battery recession and the existence of SOC of unknown initial state, SOC estimation is not accurate. The open circuit voltage method is a one-to-one correspondence between SOC and open circuit voltage (OCV), and then the estimation value of SOC according to OCV is worth to [3]. The advantage of open-circuit voltage method is that the estimation accuracy of SOC is high, but because of the existence of the intrinsic voltage of the battery, it is necessary to put the battery for a period of time when measuring open- circuit voltage, so this method is only suitable for estimation of lithium battery SOC [4]. in the static state when this method is used alone. SOC estimation method based on battery model is proposed by people in order to realize on - line estimation SOC, the most commonly used is equivalent circuit model and electrochemical model [3].

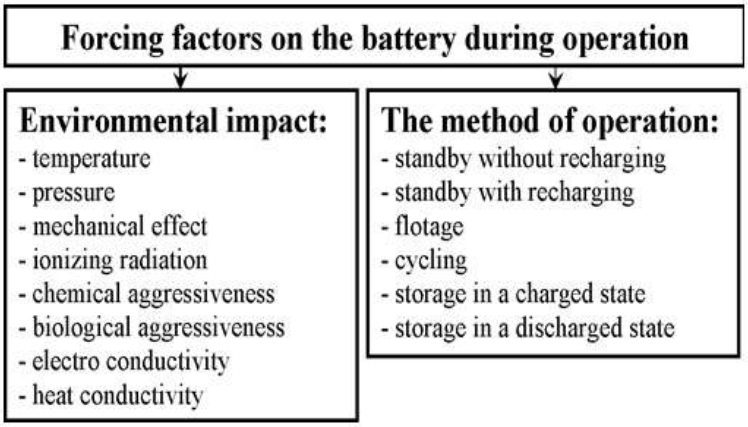

Fig 3 Forcing factors on the battery during operation**.**

3. Proposed Methodology

The equivalent circuit model is more in-depth, including the Rint model, first - order resistance capacitance (RC) model and second - order RC model and so on [1].. Due to the nonlinear characteristics of the ion diffusion process in the battery, the fractional order micro - integral is more accurate than the integer order in describing the characteristics of lithium battery. The fractional equivalent circuit model begins to enter the field of vision. The electrochemical model is based on mass transfer, chemical thermodynamics and electrodynamics, and needs a lot of calculation. This model is mostly used for battery performance analysis and battery design. Electrochemical impedance spectroscopy (EIS) method is considered to be one of the most accurate methods for modeling electrochemical systems [2].

3.1 The conflict evading algorithm based on the log sheet

There are few researches about conflict evading by the academic circle currently. The conflict evading method based on the cluster system is proposed by literature, that is, before a transaction starts, the possibility of it to have conflicts is predicted according to historical cases, and the transaction is regulated in order to reduce the failure rate of the transaction. However, there is still much to be studied on conflict evading, for example, how to collect historical conflict situations, how to improve the efficiency of conflict prediction, and how to design algorithms to compare the data and prediction set fast. A conflict evading algorithm based on the log sheet is proposed by us along with the improvement of the storage mode of the log sheet. According to the experimental verification, conflicts of the system can be reduced effectively with this algorithm and the influence of high conflict frequency on the system performance can be prevented as well.

A log sheet has to be established by this article, and the hash algorithm is used to detect the read-write conflict. The address value detected by the Hash conflict is recorded in the log sheet through

various means: direct generation when compiling, and record anytime when operating. We chose to record the address value of historical conflicts when operating to generate a dynamic log sheet for reference.

The address value and the corresponding conflict time “n” are recorded in the log sheet. “n” increases with the increase of conflict times, and the maximum value of “n” is defined as the “thread number - 1”]. For example, when the thread number is 16, the recorded conflict time “n” will be 15 to the maximum. The threshold determination is a difficult point of this algorithm. Through experimental study, it is considered that good performance can be obtained for the conflict time “n” set up as the threshold in the log sheet. A random number “p1” is assigned as the priority, and 0 < p1 < M. When the conflict evading mechanism is added, the transaction start condition is that the priority “p1” is larger than the conflict time “n” in the lot sheet, that is,

$$,P1 > N \quad (1)$$

When adding the conflict evading mechanism in the conflict detection algorithm, the description is shown below:

Input: the maximum thread number is defined, and “N” random numbers are generated. A common log sheet is maintained to record the address values and conflict time “n” of historical conflicts.

Output: regarding the output parameters, the first column is the thread id, the second is the hash address, and the third is the conflict times. The operation time (millisecond) is output as well.

Step1: The OMP_NUM_THREADS is used to define the largest thread number in the execution process.

Step2: A random number is selected for each thread as the key word, and a random number taking the thread number as the upper limit is obtained as the priority “p1” at the same time for traversal comparison with the local log sheet. For instance, when the thread number is 16, the 56478 will be obtained by some thread as the key word address value, and a random number 5 smaller than 16 will be obtained as the priority.

Step3: If the same address value cannot be found in the log sheet by the key word, then enter to Step 7 directly.

Step4: IF there is the same address value with the log sheet by the key word and the historical conflict time “n” of the address value is smaller than the priority of the transaction “p1”, the transaction can be executed smoothly to enter to Step7. For example, if the priority of some thread is a random number 5, and the historical conflict time in the same address value of the log sheet is 4, then the thread can be executed.

Step5: If there is the same address value with the log sheet by the key word and the historical conflict time “n” of the address value is larger than the priority of the transaction “p1”, the transaction shall be suspended.

Step6: Re-allocate a new random number for the transaction as the address value, and repeat step3 and step 4. If the historical conflict time "n" of the address value in the log sheet is still larger than or equal to the priority of the transaction "p2", the transaction will be suspended for re-execution until the priority "pn" is larger than the conflict time "n" in the log sheet, and then enter to step7

Step7: The transaction can be executed smoothly for conflict detection. In the detection process, in case of address conflicts of the transaction, the historical conflict time of the address value in the log sheet shall add 1.

The process of address value contrast between the transaction and the log sheet is shown in **Fig.4**

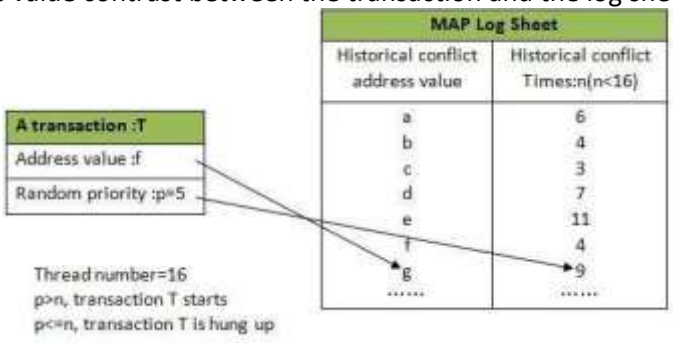

Fig 4 The address value contrast between the transaction and the log sheet

In the reaction process, the positive and negative electrode of the lead-acid battery reacted with the electrolyte separately. In the discharge process, 4 crystallization of the positive electrode was obtained by the reduction reaction of the positive electrode in the solid state insulating material state, and the crystallization was also generated by the oxidation reaction of the negative electrode plate. When crystals are too much, the plate is passivized, resulting in a decrease in the storage capacity. The positive plate in the reaction is out of the h + relatively fast, resulting in the acidic increase of the electrolyte, resulting in the corrosion of the depletion plate, which makes the capacity of the battery gradually reduced; In addition, the chemical reaction should release heat in the process and the reaction speed is positively correlated with the temperature, leading to the higher temperature sensitivity of lead acid battery [5]. The **Fig 5** shows the charge- discharge profile.

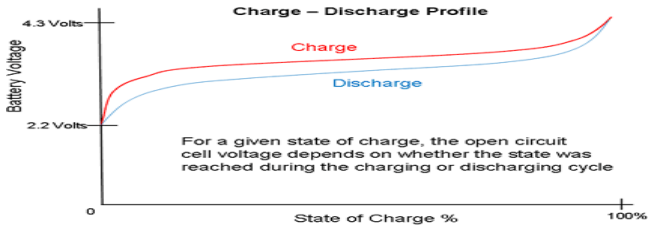

Fig 5 Charge- Discharge Profile

Therefore, the lead acid battery needs to avoid over - charging, excessive discharge in the transportation line, and should be periodically charged and put on the maintenance, so as to avoid the long-term floating charge caused the plate passivation

3. 2 Electrochemical Impedance Performance

Electrochemical impedance spectroscopy (EIS) is an experimental method to obtain the response characteristics of lithium battery. In this paper, a set of small amplitude sine wave AC current x with different frequency is applied to the lithium battery, and then the output of the battery is measured with the same frequency sine wave signal Y [7], the relationship between X and Y is as follows:

$$G(W) = Y(w)/X(W) \qquad (2)$$

The image of g (ω) in the complex plane is the electrochemical impedance spectrum of lithium battery. The same lithium battery in different SOC state, due to the differences in the internal electrochemical status, the impedance spectrum is not the same [6]. In this paper, the impedance spectrum of the lithium battery in the range of different SOC and from 0.005 to 5 Hz is shown in **Fig 6**

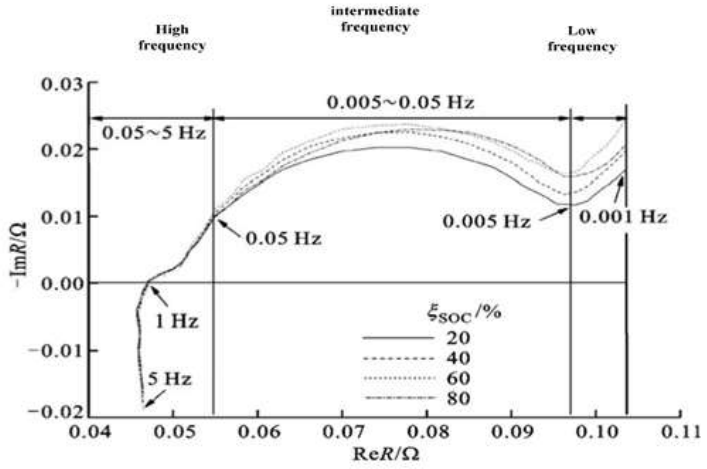

Fig 6 The Impedance Spectrum of the Lithium Battery

EIS is a very effective method to study the electrochemical intercalation reaction mechanism. Because of the difference of the relaxation time in each step of Li - ion intercalation, EIS can reflect different embedded reaction process in a wide frequency range. The surface layer model [7] is a widely accepted model of electrochemical intercalation reaction mechanism. According to Thomas, in normal conditions, the surface layer electrolyte is attached to the surface of the gomphosis electrode, while the ionic conductivity of the surface layer electrolyte is smaller than that of the

liquid electrolyte, and the diffusion migration process of ion passing through the surface layer can be expressed by the parallel circuit of the capacitance composed of the ionic embedded resistor and the surface layer electrolyte [8]. Li - ion battery equivalent circuit model was shown in Fig 7

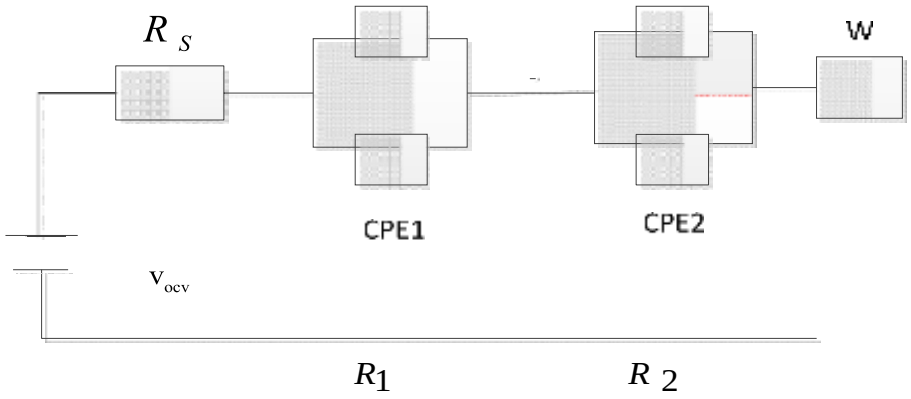

Fig.7 Li - ion battery equivalent circuit model

In the impedance spectrum, lithium cell in different SOC States is different, but there is a high degree of consistency in its shape [9]. Therefore, the equivalent circuit model is universal in different SOC States, and the equivalent circuit model is shown in figure 7. In the figure: r s is the ohmic resistance of the lithium battery, indicating that the voltage divider of the ohm resistor is v s, and the intersection of the high frequency curve and the real axis in the impedance spectrum [10].

The R is in parallel with the constant phase element CPE 1 to represent the concentration of the lithium ion battery polarization, and the flat half - circle curve segment of the high frequency band corresponding to the impedance spectrum; The R is in parallel with the constant phase element CPE 2 to indicate the concentration difference polarization of the lithium battery, and the flat semicircle curve segment corresponding to the middle frequency band of the impedance spectrum; W is the war element, indicating the activation polarization of the lithium battery and the linear segment of the low frequency band.

3. 3 The Advantages of Lithium Iron Phosphate Battery in the Performance of Monomer

The lithium iron phosphate battery in charge and discharge chemical reaction material has good thermal stability, so that the more ideal monomer technology can battery monomer has good operating safety: the redox temperature of LiFePO4 is more than 400, according to the accelerated adiabatic calorimeter test data, the temperature range of the lithium iron lithium battery reaches - 20℃~ 75 ℃, there will not be thermal runaway phenomenon, excellent charging and discharging performance. Through the simulation of state of charge (SOC), the charging and discharging characteristics of LiFePO4 battery are verified [11]. According to the test data of some

manufacturers, the current charge of lithium iron phosphate battery with 1.5 c discharge rate can be full of about 40 minutes.

The discharge rate can be charged at a rate of 2c, and 90 % of the capacity can be released when the discharge rate is 3c. The high rate discharge and there is no memory characteristics of lithium iron phosphate battery make it especially suitable for the application mode of high capacity relative small, short time fast output power and frequent charge and discharge [12].

At 25, the charge-discharge cycle of lithium iron phosphate lithium battery monomer is 2,000 times, and more than 1,000 times. When the ambient temperature is obviously higher than 25℃, the valve regulated lead acid battery increases about 10 ℃ and shortens the life span by 50 %. However, the lithium iron phosphate battery has no influence on the lithium iron phosphate battery. The energy density of the battery is the electric energy released by the average unit volume or mass of the battery. Referring to the production data of current domestic batteries: when the serial parallel battery series is parallel to 48 v and the same capacity storage pool group, the volume of the LiFePO4 battery pack is about 1 / 3 of the valve regulated lead-acid battery, and the weight is less than 1 / 4 of the valve regulated lead-acid battery. The lithium iron phosphate battery in charge and discharge chemical reaction material has good thermal stability; so that the more ideal monomer technology can battery monomer has good operating safety. Lithium iron phosphate battery was shown in **Fig. 8**

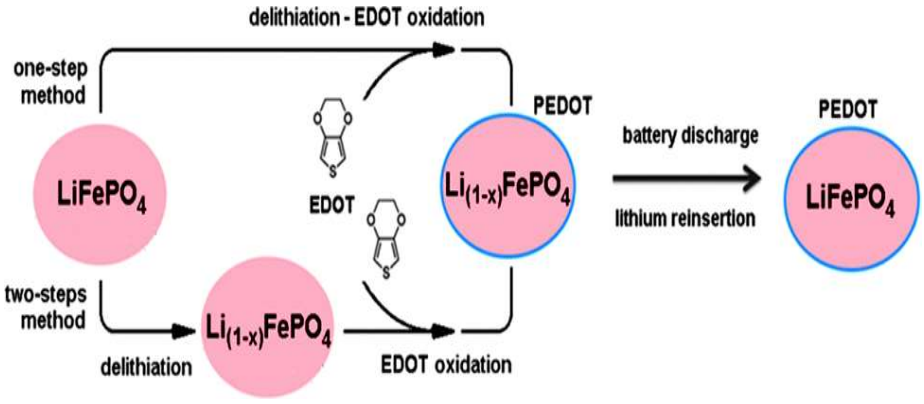

Fig.8 Lithium iron phosphate battery

3. 4 Development and Application Prospect of LiFePO4 Battery

- National policy supports the green industry. The lithium iron phosphate battery is not involved in any toxic and harmful substances and products in its production and operation until the end of the whole life cycle, because of its excellent environmental protection performance is increasingly supported by more and more national policy [13]

- The requirement of the construction and upgrading of the computer room under the concept of distributed cloud data center requires the storage battery in the ups system is smaller, lighter and has higher capacity density. In addition, the temperature characteristics of phosphorus lithium battery also comply with the concept of the construction of the green room, can support the it equipment or ups power supply system room temperature rise to 30 ℃ to 35 ℃ for higher energy efficiency [14]. **Fig. 9** shows change rate of influencing factors

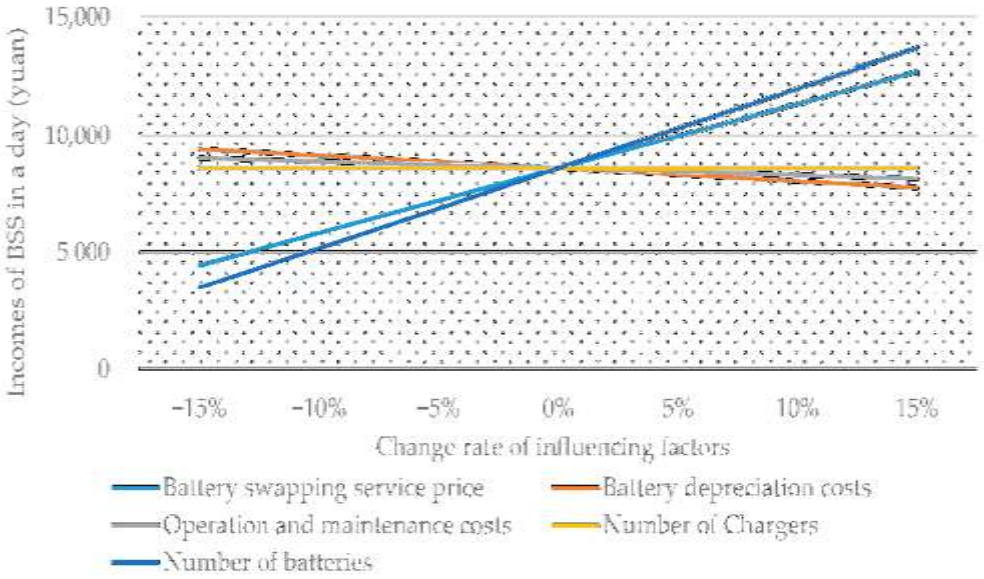

Fig 9 Change rate of influencing factors

- Ups manufacturers accelerate the marketization process of the ups products of lithium battery pool. From the comparison of the balance technology of LiFePO4 battery and VRLA battery, it can be found that the main thinking way is to adjust the state of charge in the whole battery in time, and make the whole battery meet the required consistency. From the current research situation, the research and development of the two is not very different, but the valve regulated lead acid storage pool appeared earlier and lower cost, so the strong support of mainstream ups manufacturers [15]. At present, most of the small and medium ups manufacturers have realized that the ups system of lithium battery is more mature, and it will push out the small capacity of the lithium battery ups products to break the development opportunity of market monopoly. And the mainstream ups manufacturers are not in the rut, a well-known manufacturer of large capacity ups units in battery management with intermittent charge and discharge management and real-time status monitoring technology, can see that it has made a large capacity lithium battery ups unit technical preparation.

3. 5 The Energy Storage Type Application of Lifepo4

Battery is increasingly expanded. now, the - 48 v DC power supply system and the small capacity ups system with the lithium iron phosphate battery have been widely used in the communication industry, the main occasion is the small room with high ambient temperature such as communication base station. In addition, the an on-board and mobile power supply system used in the broadcast television industry and the power supply of the distributed signal monitoring station also apply to the lithium iron phosphate battery. With the further improvement of the lithium iron phosphate battery equalization technology, the capacity of the supporting ups system will be significantly improved [16-19].. In the traditional small and medium-sized data room integration upgrade to the distributed cloud data center process, the excellent DC power supply system of LiFePO4 battery and the deployment of flexible rack iron phosphate lithium battery ups system will be more application.

4. Experimental Results and Analysis

The C ++ MAP is used to protect the local log sheet. MAP is an associative container which can automatically create the corresponding Key-Value. Key and value can be defined by users who can conduct inquiry, deletion and modification operation fast for elements in the MAP, thereby realizing the inquiry, deletion and conflict time addition operations for historical conflict address values.
The hardware platform of the experiment is: Intel 22 nanometer Core i5-3450 4-core processor, CPU clock speed 3.7GHz, memory 8G. Software platform: Microsoft Windows 7 operating system, Microsoft Visual Studio 2010 (OpenMP) + Intel Parallel Studio XE 2013, and C ++ programming language is applied.
The RHR performance contrast between the algorithm added with the conflict evading mechanism and the original algorithm is shown in **Table 1**.

Table 1 The performance contrast between the P-RHR and RHR

Thread number	Conflict times		Operation time / ms	
	Conflict evading	No conflict evading	Conflict evading	No conflict evading
2 threads	7	13	880	12.3
4 threads	13	25	774	11
8 threads	26	44	668	10.1
16 threads	38	71	575	9.7

As can be seen from the table, the algorithm with conflict evading mechanism takes more operation time than the algorithm without conflict evading, because the regulation has to be conducted each time before the transaction starts and it requires certain performance consumption. However, the thought of conflict evading algorithm is “taking precautions”, “focusing on stability at the cost of time”. Although it takes much time, advantages of conflict evading are obvious. Experimental results

show that the conflict time between threads in the conflict evading algorithm is clearly less than that without conflict evading. In this way, over half of the conflicts can be reduced. With the increase of thread number, the conflict time increases and operation time decreases

5. Conclusion

Pure electric vehicles, hybrid electric vehicles and increase electric vehicles with low pollution and low consumption become the most potential substitutes for the traditional fuel vehicles at present, while the power battery and its management system of electric vehicles, the drive motor and electric control become the key to its development. Lithium iron phosphate lithium battery is in line with the trend and trend of the development of the times, the state of charge estimation method is becoming more and more mature. When the opportunity comes from the society or the market, the lithium iron phosphate battery will quickly break through the monopoly status of the valve regulated lead-acid battery in the energy storage application field, and then obtain the accelerated development, and ultimately replace the valve regulated lead acid battery to become the mainstream storage battery. This paper applies it to the transaction memory design based on the multicore PC. By predicting the probability of transaction conflict occurrence before executing the transaction, it is to control the transaction occurrence and reset, thus preventing the influence of high conflict frequency on system performance. Experimental results show that the parallel algorithm with the addition of conflict evading mechanism can avoid major conflicts, and its operation speed is significantly improved compared with the original algorithm.

References

[1] Xuanju Dang,Li Yan,Hui Jiang,Xiru Wu,Hanxu Sun. (2017), Open-circuit voltage-based state of charge estimation of lithium-ion power battery by combining controlled auto-regressive and moving average modeling with feedforward-feedback compensation method. International Journal of Electrical Power and Energy Systems, 9 (2). 12-19

[2] WANG Deng-Jun, WANG Yan-Li, ZHAN Liang, ZHANG Xiu-Yun, Liu Chun-Fa, QIAO Wen- Ming, LING Li-Cheng. (2011), Graphitization Mechanisms and Electrochemical Performance of Needle Coke Anode for Li―ion Battery. Journal of Inorganic Materials, 26 (6). 12-19

[3] Wenxiu Ji,Liang Cai,Qinkun Men,Gaofeng Sun,Xiaosong Zhang. (2016), Build and Test Research of a Coaxial Hybrid-power Gas Engine Heat Pump System Based on LiFePO4 Battery. Procedia Engineering, 146 (12). 12-19.

[4] Y. Firouz, J.M. Timmermans, N. Omar et al. (2016), Advanced lithium ion battery modeling and nonlinear analysis based on robust method in frequency domain: nonlinear characterization and non-parametric modeling. Energy, 07 (32). 12-19.

[5] Maitane Berecibar, Maitane Garmendia, Iñigo Gandiaga et al. (2016), State of Health estimation algorithm of LiFePO 4 battery packs based on differential voltage curves for battery management system application. Energy, 11 (28). 32-39.

[6] Alexandre Lucas, Stamatios Chondrogiannis. (2016), Smart Grid Energy Storage Controller for Frequency Regulation and Peak Shaving, using a Vanadium Redox Flow Battery. International Journal of Electrical Power and Energy Systems, 22 (24). 2-19.

[7] Seung-Keun Park, Chae-Yong Seong, Suyeon Yoo et al. (2016), Porous Mn 3 O 4 Nanorod/Reduced Graphene Oxide Hybrid Paper as a Flexible and Binder-free Anode Material for Lithium Ion Battery. Energy.

[8] D. Choi, A. Negussie, R. Seifabadi et al. (2016), Battery-powered electrified conductive vascular access device minimizes fibrin sheath adhesion. Journal of Vascular and Interventional Radiology, 27 (3). 72-79.
[9] L.Sharmila, U.Sakthi, "Search Algorithm for Multiple Histories Using Time-Sorted Array", Journal of Computational and Theoretical Nanoscience, Vol. 15, No. 9/10, pp. 2917–2919 (2018).
[10] Qiuling Chen, Qingwei Wang, Qiuhua Ma et al. (2016), Influence of surface coating on structure and properties of metallic lithium anode for rechargeable Li-O 2 battery. Boletín de la Sociedad Española de Cerámica y Vidrio, 10 (2). 112-119.
[11] David Bradley. (2016), Battery boost with GMOs. Materials Today, 19 (5). 122-129.
[12] L.Sharmila, U.Sakthi, "Cloud Security Risk Analysis Method based on Fuzzy Logic",International Journal of Recent Technology and Engineering, Volume-8 Issue-3, September 2019.
[13] Lin C C, Peng H, Grizzle J W, et al. (2013), Power management strategy for a parallel hybrid electric truck. IEEE Trans Control Syst Technol. IEEE Transactions on Control Systems Technology, 11 (6). 839-849.
[14] Bastawrous H. (2015), Online state of charge and model parameters estimation of the LiFePO4 battery in electric vehicles using multiple adaptive forgetting factors recursive least-squares. Journal of Power Sources, 296 (November). 215-224.
[15] Shaofei Wu,A Traffic Motion Object Extraction Algorithm,International Journal of Bifurcation and Chaos,2015,25(14).Article Number 1540039.
[16] Bloom B H,Space/Time Trade-offs in Hash Coding with Allowable Errors,Communica-tions of the ACM, 1970, 422-426.
[17] Lin,P. An Adaptive Collision Detection Algorithm in Transactional Memory. Computer Engineering and Science, 2009,31(11). 69-72.
[18] Shi, D. X. Dynamic Competition Management Strategies of Software Transactional Memory. Software Guide, 2012,11(3). 6-8.
[19] Lin, F. Dynamic Competition Management Strategies of Software Transactional Memory. Computer Engineering and Design, 2010,7(9). 1510-1512.