Study for annealing and genetic algorithm in automatic process of data collection in computer software test run

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ABSTRACT

The concept of simulated annealing algorithm is derived from the organic integration of optimization and thermal equilibrium in statistical mechanics. This algorithm simulates the process in thermal equilibrium of natural cooling after being heated. In the process of finding the optimal solution, this algorithm shows a big advantage as it regards to be a technical approach to find the optimal solution. In this algorithm, the extremes should be considered as a function of dynamic equation. Although simulated annealing algorithm can avoid focusing on the local optimal solution, there are still some drawbacks, such as large amount of calculation and poor efficiency. Genetic algorithm (GA) simulates the natural law in biology: survival of fittest. It runs a "global optimized" algorithm, which appeared several years earlier than simulated annealing algorithm. Actually, GA is a set of arithmetic algorithm used in a group. It is necessary, at beginning, to choose a group of original population. Then, by crossover and mutation, some new population will be produced. This process goes on generation by generation, and always chooses the optimized ones to survive. As a result, the global optimized solution will be worked out. In this research, simulated annealing algorithm and genetic algorithm are combined to develop their biggest advantages to obtain the optimal solution. It is proved by test that this method is more suitable for seeking the optimal solution, especially, in automatic process of data collection in computer software test run. Its main advantages are high accuracy, convergence speed and high practical value, etc.

KEYWORDS
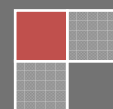
INTRODUCTION

There have been already some studies about genetic algorithm used in automatic generated path oriented test data[1]. As computer technology and network communication technology develop with incredible speed, there are increasingly information needs for computer technology in different fields and departments. Especially, as the concentration in industrial designs grows, the designs need to be more diversified and the requirements for designs have also improved. Application of computer technology has brought a revolutionary change. It makes the industrial designs more scientific and more professional. Due to all kind of new technologies, the industrial designs are drawing a beautiful blueprint. To address this issue, some universities have developed their existed management software for the computer labs according to their own needs. They also have achieved some success. But this is a big puzzle for most universities. With the ever-changing computer hardware, software and other technology, virtual realization, multimedia, computer-aided design, graphic design and other techniques have great impact on studying industrial design methods and theories. A better way is to combine genetic algorithms and simulated annealing to build simulated annealing genetic algorithm[2].

Simulated annealing genetic algorithm combines genetic algorithm and simulated annealing algorithm constituting an optimization algorithm. Computer-aided Industrial Design refers as CAID. In the industrial design related fields, with the help of both industrial designs aided systems and computer, all kinds of designs and creations can be done. Compared to traditional design methods, CAID has obvious advantages no matter in the design quality, method and process[3]. For device administrators, they need to follow the initial information of devices and their service conditions. They also need to monitor the computer hardware in the lab real-time whether it need to recover or update. For educational administrator, they need professors to provide the projects of practice works, the grades of the students' performance on computers and the rate of students' attendance. For professors and students, their needs are the projects of practice works, report of practice works and the output of final results.

Model based on SAGA test data

The model structure that generated by simulated annealing genetic algorithm test data is shown as Figure 1. In different production areas, the core of industries is product design; this can be called the core concept of the product[4]. The idea is fully reflected in three aspects, product design development has the consistency with this idea. And this idea is a breakthrough of concept. But the other factors in the daily management must be integrated into the platform. A standardized business process should be formed and should be presented in the form of files. It is convenient and efficient to show the various information of each laboratory in this way. At the same time, it contributes to the information-standardized management in laboratory. And data sharing for different electronic archives can be achieved in this way. These are the archiving process for the information of laboratory itself. As this is a real-time platform, it can follow and analyze every step in the experiment. The designer should apply their innovative design, such as inventive and creative design, unreservedly in the new outcomes.

Test module

The parameters set $x(x_1, x_2, ..., x_n)$ of input space D consists the input of tested module. With the overall look to the production design, the whole life cycle, agile design, virtual design, intelligent design, collaborative design, concurrent design and other design methods point out the direction of development of computer-aided industrial design[5]. The test module includes the submission, count and inquiry of the experiment projects. The professor-users submit the complete experiment plans and the platform administrators associate the experiment room and time with those plans. If there is no conflict, the plan should be kept. Otherwise the plan should be changed by the professor-users. Suppose there are m branch points and n parameters, thus there are m branch functions: $\varnothing_1 = f_1(x_1, x_2, ..., x_n,)$, $\varnothing_2 = f_2(x_1, x_2, ..., x_n,)$,

$\varnothing_m = f_m(x_1, x_2, ..., x_n)$, , the linear functional of this path is: $F = \Phi(\phi_1) + \Phi(\phi_1) + ... + \Phi(\phi_m)$, here $\Phi(x) = \begin{cases} 0, x \le 0 \\ x, x > 0 \end{cases}$.

Definition: Suppose C (D) presents the whole branch function in parameter space D. For any two points ϕ_1 and ϕ_2, the addition and the distance between these two points are defined as: $\rho(\phi_1, \phi_2) = \max_{(x_1, x_2, ..., x_n) \in D} |\phi_1 - \phi_2|$. Obviously, if $\rho(\phi_1, \phi_2)$ satisfies norm axioms, C (D) is a normed linear space. F is the linear functional in C (D), and the minimum value of F is 0.

SAGA module

SAGA module put a heuristic search in practice in parameter space D. Compared with the technology in architectural aspect, the development of computer-aided industrial design more slowly[7]. The reason is, compared with technology in mechanical and architectural aspects, industrial design is more integrated and complex. The distance $\rho(\phi_1, \phi_2)$ decreases, and finally converges to 0. At this moment, the value of F is also 0. This is said that a set of optimal parameters has found and it becomes the required text data.
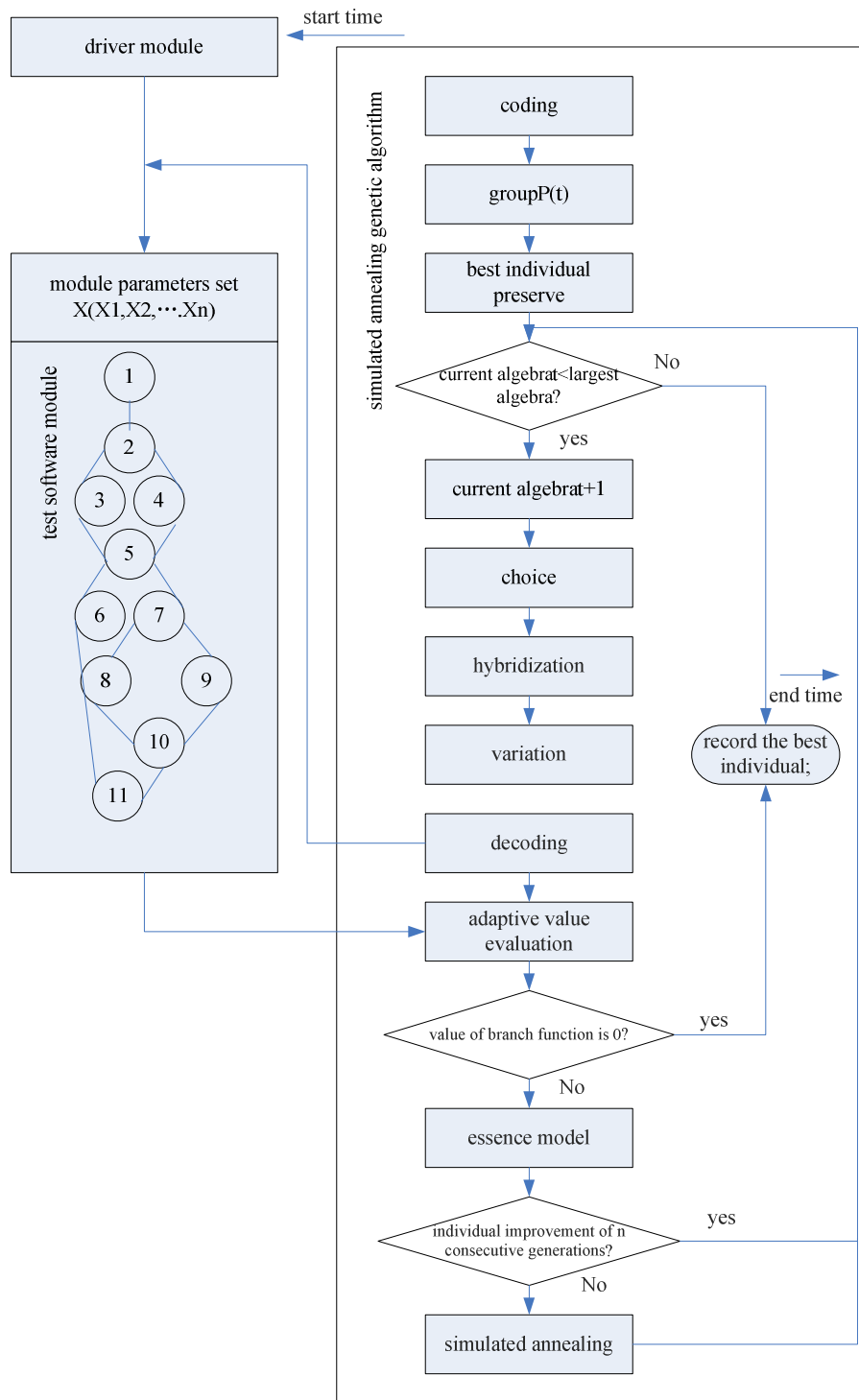
Figure 1 : Mmodel structure that generated by simulated annealing genetic algorithm test data

Module crosslinking

  The crosslinking between test module and SAGA module is: As computer technology and network communication technology develop with incredible speed, there are increasingly information needs for computer technology in different fields and departments. Daily manual management mode has been obsolete, especially in the computer labs of universities.

Stopping criterion

  The stopping criterion of SAGA test data generation is when the value of F is 0. In this paper, by finding the inadequate in management of the computer labs, to combine the different information requirements for each administrative department with the task management processes, based on the analyzing the information requirements of computer labs,

rooted in.NET, a computer lab archival management platform that can meet the need of daily work of management is designed.

DESIGN OF SAGA ALGORITHM APPLIED TO TEST DATA GENERATION

SAGA Algorithm design in this paper introduces simulated annealing algorithm into the selection operation of genetic algorithm. As computer and network become more and more popular, computer technology improves day by day and the prices of computer decreases continuously, those make the computer popularized. Computer becomes the essential tool in daily life. In universities, laboratory is a space where the experiments take place. Those labs can be called as the base of scientific research, and the hometown of technology development. For these reasons, the money and human resource that have been put in building and developing the labs, especially those computer labs that develop with incredible pace recently, are huge. In order to meet the requirements of study and work, various computer labs have come into being. And the classification is becoming clearer. So the management requirements in computer lab also need to improve. For the managers, the duty is not only to take care of all equipment in the lab, but also to classify and analyze all kinds of files based on optimizing the computer resources. Those files can provide the basis for managers to draw a long-term development policy. But by the situation now, the management methods of computer labs in most universities have time-delay. They still rely on manual management. The lab administrators suffer high work pressure in this case. Thus the development of a computer lab management platform is necessary. The platform not only makes the management standardized and scientific, set the administrators free from the heavy labor. It can also provide referent data to decision-makers in a sense. This platform makes the individuals after mutating only vary in a small range. So the time to find the optimal solutions gets shorter.

Method to combine simulated annealing algorithm and genetic algorithm

Generally, there are two methods to combine simulated annealing and genetic algorithm. Now most universities enrich their investments in laboratory infrastructure and hardware devices. As computer technology and network technology develop in a high pace, the development of software is far behind that of hardware. In order to solve this problem, some universities have improved their own computer lab management software and have achieved some success. But a large number of universities are concerning about this problem. In these universities, the management in the computer lab is still done with manual work. The administrators suffer from the heavy work. And the work efficiency is poor and it is easy for administrators to make mistakes in the large amount work as saving and query. Since the main management method is manual, it is hard to handover the file-turn-data to the decision-makers. And it is also hard to provide the scientific basis to the development of laboratory. In this background, it is become more important to design a workflow for computer lab, which means a computer lab management archived platform with convenient and easy-operated display and an ability to make data lists. Viewing from the computer lab management, this platform' main job is to realize the standardized management for experiment files. This management includes the records of data and the management files installation. The former one refers to follow and record all the generated data in each step. The latter one refers to the formation of standardized management files.

Genetic module

In this paper, the traditional roulette method is used as the selecting operation in SAGA algorithm. Above all, by analyzing all information requirements, it could be learnt that this platform integrates the management of equipment, education and platform itself. For the management of equipment, all information about hardware, maintenance and disposal is needed. For the educational management, the information of experiment rooms and corresponding projects should be clearly presented. Professors and students could log in to check the experiment projects. And on this platform, professors can enter the records of students and students can submit the reports. For the platform itself management, the different users should be given the different rights. In this way, the safety and stability of platform can be ensured.

The platform that has been designed in this study can fulfill the needs of all users above. The daily management work must be integrated to the platform, too. All information should be archived and a standardized process should be formed. In this way, all information about laboratories could be shown fast and conveniently. The platform helps with the standardizing different kinds of information of lab management. It can realize the data sharing of different e-files. These are archived process of the lab information. As this is a real-time platform, it can follow and analyze all steps in the experiment process. The maintenance of equipment on time is not the only benefit. The historical information that stores in the platform can make the check work much easier for administrators when problems appear.

Simulated annealing module

The work process of simulated annealing module shows in Figure 2.

EXAMPLE STUDY

Lastly, a classical triangle problem has been chosen to do the test. The design platform must satisfy the management function. It should meet the demands as below to ensure the stability of system during the process. Firstly, the design of platform can set the administrators free from the manual management mode. While improving the efficiency, the work

process should be more standardized. So the platform must be stable and reliable. Secondly, this platform will run inside the whole campus, so it should equip with openness. This is a necessary condition for adding labs in the other majors one day in the future. Finally, there are a huge number of users of this platform, so the design must be humanized. The platform should operate in an easy way and user-friendly.
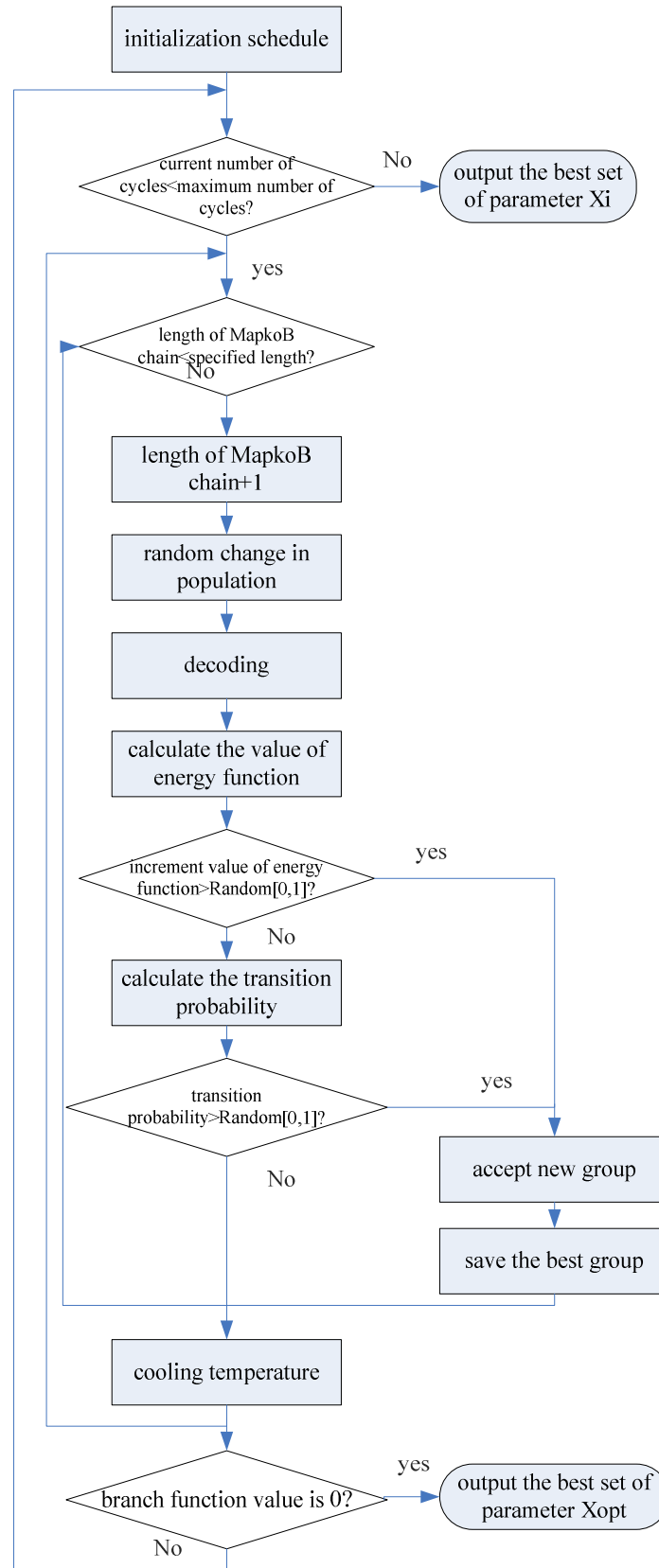

Figure 2 : Work process of simulated annealing module

Example of test module

The triangle problem has clear but complex logic. In this paper, the computer lab management archived platform contains two parts, named as work process for educational administrators and the support process. The former one starts from the experiment teaching management to build the files including projects, records, attendance and reports and make the staff processed.

Implementation of SAGA model

Implementation language: in the test referred in this paper, the second module in the used generated SAGA test data model is designed as the experiment teaching module. It includes the submission, count and check of experiment projects. The professor-users submit the complete experiment plans and the platform administrators associate the experiment room and time with those plans. If there is no conflict, the plan should be kept. Otherwise the plan should be changed by the professor-users. The mutation rate is 0.15, the initial temperature is 600, the cooling function is 0.95, and the MapkoB chain is a 10-equilength chain.

Test result

Generation of equilateral triangle path test case

Genetic algorithm and simulated annealing genetic algorithm are applied to generate 10 times of equilateral triangle path test case separately. Note the operation time. The operation time for these two algorithms is shown in Figure 3.
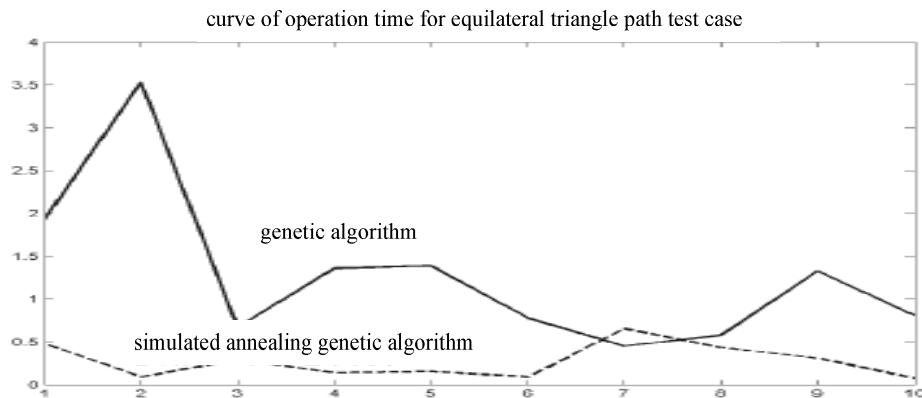

Figure 3 : Operation time for equilateral triangle path

Generation of right triangle path test case

The operation time for these two algorithms is shown in Figure 4.
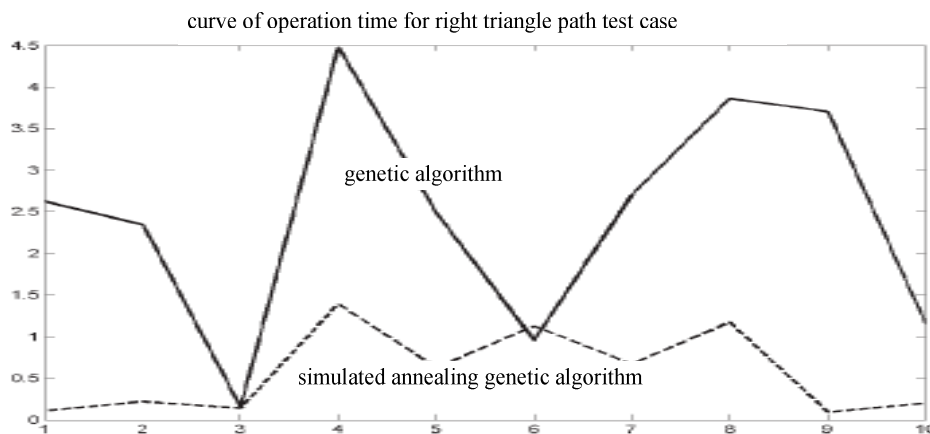

Figure 4 : Operation time for right triangle path

It shows obviously in Figure 4 that simulated annealing genetic algorithm has a higher efficiency than genetic algorithm.

Analysis test case of a certain cover path that generates automatically

In the equipment management, administrator can survey and check the condition of equipment according to the historical statistical data. In the module of maintenance management, the journal and report of maintenance, as well as the function of reservation, are included. Professor-users can use the reservation function to reserve the software environment needed in teaching (Figure 5). Student-users can use this function to report the equipment trouble. It is more convenient for the administrator to repair the equipment, install and update the software. The equipment management and maintenance module mainly uses to complete the second part of computer lab management archived platform, which is to build support process for educational management profile to improve the efficiency of the algorithm.
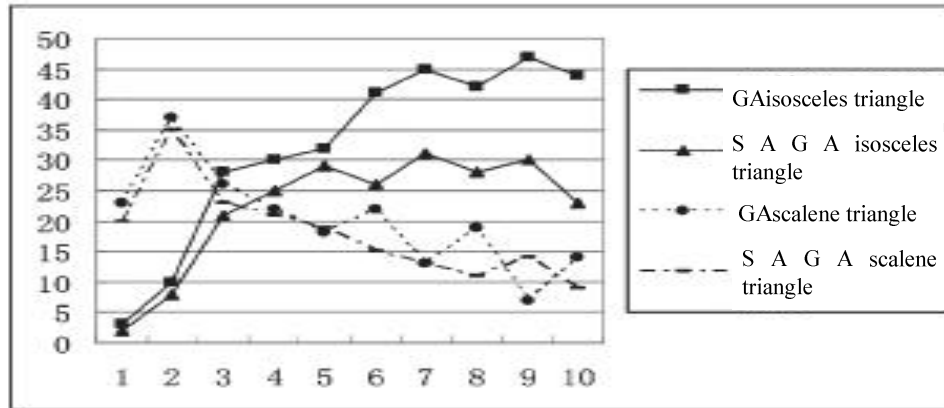

Figure 5 : Generation of isosceles and scalene triangle test case

CONCLUSION

In this research, simulated annealing algorithm and genetic algorithm are combined to develop their biggest advantages to obtain the optimal solution. It is proved by test that this method is more suitable for seeking the optimal solution, especially, in automatic process of data collection in computer software test run. Its main advantages are high accuracy, convergence speed and high practical value, etc.

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