Optimal solution analysis of octagonal Steiner tree problem based on GPU acceleration

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***Absrtact*—In order to improve the effect of solving the octagonal Steiner tree problem better, the optimal solution analysis of octagonal Steiner tree problem based on GPU acceleration is proposed. Combining with prim algorithm, the relay point of octagonal Steiner tree is cut in. In order to better shorten the routing path, the GPU acceleration principle is used for global search, the routing path is scientifically standardized, the range of inflection point is reasonably defined, and the research requirements for effective analysis of the optimal solution of octagonal Steiner tree problem are finally realized. Finally, it is proved by experiments that the GPU accelerated optimal solution analysis method for octagonal Steiner tree problem is more effective in practical application, and can effectively improve the data convergence and fully meet the research requirements.**

Keywords- GPU acceleration; Steiner tree; optimal solution

I. INTRODUCTION

In view of the problem that Steiner tree is easy to run in bad environment, this paper proposes an optimal solution analysis method of octagonal Steiner tree problem based on GPU acceleration, which uses the principle of GPU acceleration to segment the grid with high separation, combines the prim algorithm to detect the relay points of octagonal Steiner tree, and obtains the node characteristic partition of octagonal Steiner tree[1]. The global search is based on GPU acceleration principle. In order to ensure the speed of data access and grid division, the Steiner tree approximation algorithm is improved by combining the spatial range features, and the data features are classified and arranged. According to the robustness of the Steiner tree structure of the grid relay node, the connectivity recovery processing is carried out, and the structure features of the smallest middle point of the tree are collected. According to the collection results, the data inflection points are standardized, so as to obtain the octagons[2]. The optimal solution of Tanner tree problem can better ensure the normal operation of network data. Combined with the CPU acceleration method, the information collection level and optimization processing are carried out to maintain the normal operation of the network, improve the Steiner tree solution effect and fault tolerance rate, and better promote the research requirements of modern network development.

II. THE OPTIMAL SOLUTION OF OCTAGONAL STEINER TREE PROBLEM

A. accelerated optimization of octagonal Steiner tree GPU

The problem of octagonal Steiner tree is solved by GPU acceleration method. In order to ensure the optimization effect, the GPU acceleration optimization mode is improved[3]. CUDA is used to collect and analyze the octagonal Steiner tree characteristic values, and the collection results are run to the CPU device[4]. The dynamic characteristic values are randomly divided by the combination control system and DRAM software, and the grid characteristic types are classified Divide, distribute relevant information to memory, and integrate execution units of massive data. Optimize abnormal data. Based on this, first build GPU acceleration model, as shown in the following figure:

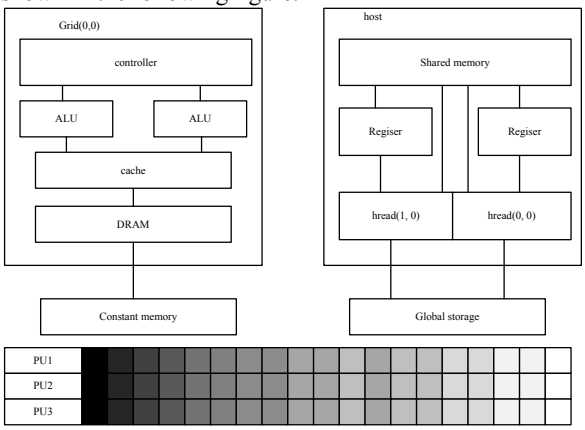

Figure 1 GPU acceleration model of octagonal Steiner tree

Based on the above model, the parameter properties of octagonal Steiner tree are optimized. In order to ensure the speed of data access and grid division, the Steiner tree approximation algorithm is improved by combining the spatial range features, and the initial tree enumeration features of data are further collected[5]. In combination with the improved TM algorithm, the 2-layer and 3-layer tree structures are standardized, and the Steiner Book scores are divided from the root node , and standardize and record the Steiner tree GPU acceleration interference factors and influence values. The specific specification values are shown in the table below:

Table 1gpu acceleration interference value

category	On chip / on board	Cache yes / no	Operation permission equipment	Host side	Read / write speed
register	On film	--	read-write	--	fast
Shared memory	On film	--	read-write	--	fast
Local memory	On boar	nothing	read-write	--	slow

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	d				
constant memory	On board	existence	readable	read-write	Faster
Texture memory	On board	nothing	read-write	read-write	Faster
Global storage	On board	existence	readable	read-write	slow

Based on the information in the above table, further standardize the turning point and routing of Steiner tree problem, set the routing definition, and ensure the solution effect of octagonal Steiner tree[6].

B. Routing specification for Steiner tree problem

In order to better shorten the routing path and standardize the turning point and routing of Steiner tree problem, in the octagonal Steiner tree structure, select and standardize the Steiner point inspection: in the spatial structure of Steiner tree, if there are n given feature points, in order to ensure the data processing effect, ensure the branch turning point routing of Steiner tree, and ensure the data connection effect, constitute the smallest tree middle point[7]. Features are collected, e is recorded, and then the points and sets of Steiner tree are further constructed, and the distribution of Steiner points is standardized according to the structure. In the spatial structure, the internal angle of the triangle is standardized. If the maximum angle value is 120 degrees and the minimum angle is 30 degrees, the internal structure of the triangle in Steiner tree is standardized[8]. The determination method of point routing is as follows:

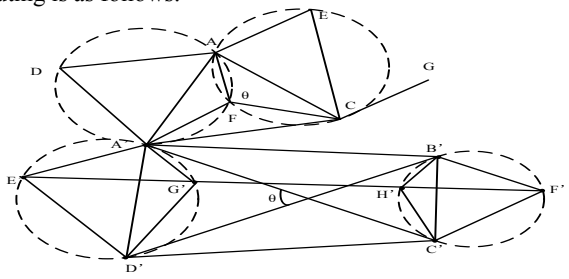

Figure 2. Determination of Steiner point routing

Based on the above structure, firstly, the quadrilateral Steiner tree structure and node distribution are optimized, and the relay point of octagonal Steiner tree is cut in with prim algorithm[9]. Through the way of relative standard, the differences between different evaluation factors are distinguished regularly and quantitatively, and the hierarchy of evaluation factors is clearly distinguished[10]. According to the relevant principles of fuzzy research, the hardness fuzzy subordinate function of each evaluation factor in the evaluation system is determined. If the required number of nodes is Q, and the angle change of any node in the quadrilateral Steiner tree structure is m, then If the minimum generating construction node of octagonal Steiner tree is n, then calculate the feature of lucky points in quadrilateral and octagonal Steiner tree respectively, and get the average node degree as follows:

$$AvND_{\text{Trilateral Steiner tree}}: [3m*n+(D-2)*n]/2\theta*(H-H')(E-E')(D-D') \quad (1)$$

$$AvND_{\text{Octagonal Steiner tree}}: [7m*n+(D-C_0)*n]/4\theta(G-G')(B-B')(E-E') \quad (2)$$

$$AvND_{\text{minimum spanning tree}}: [m*n+(D-1)*n]/\theta(C-C')(B-B')(A-A') \quad (3)$$

In the calculation process, ensure that the Stana average node degree value meets the following requirements:

$$AvND_{\text{Octagonal Steiner tree}} \le AvND_{\text{Trilateral Steiner tree}} \le AvND_{\text{minimum spanning tree}} \quad (4)$$

Based on the above algorithm, further expand and optimize the tetragonal Steiner tree structure, and further expand and analyze the octagonal Steiner tree feature structure based on the quadrilateral feature[11]. Taking the grid node feature as the reference standard, divide the Steiner tree segmentation grid structure with Z as the minimum spanning tree link point, t as the network segmentation time in the spatial structure, and s as the isolated point In addition, the connection recovery of Steiner tree structure is further processed based on the following principles:

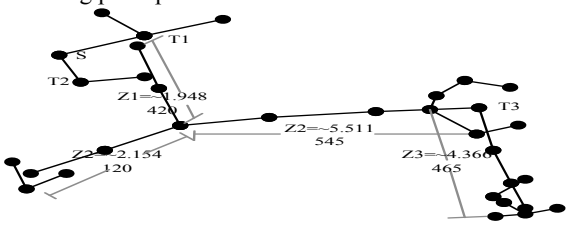

Figure 3. connection restoration of Steiner tree

Based on the above method, the Steiner tree connectivity restoration value is further calculated, the calculation software MATLAB is used to calculate the participants, and then the corresponding deviation equation is described. Suppose the node clustering value in octagonal Steiner tree structure is k, and the distribution network line of Steiner tree is n = {N1, N2 , NM}, then calculate the connection value of the fully connected pin in different wire network structures, which can be recorded as follows:

$$L_{\text{Quadrilateral Steiner tree}} = \sum\sum N(Z_0 + Z_1 + Z_2 + Z_3)^k \quad (5)$$

$$L_{\text{Octagonal Steiner tree}} = \sum\sum Z_0 + Z_1 + Z_2 + Z_3 + T_1 + T_2 + T_3 \quad (6)$$

Based on the above algorithm, the two-dimensional structure of mechanism network r is further calculated to obtain vector data, and the attributes are extracted and processed by using one-dimensional curvature image of viewpoint[12]. If the minimum line length cost value of octagonal Steiner tree structure is u, then each line network Ni is further calculated for octagonal network[13]. All corresponding pins are connected to form a Steiner tree routing algorithm for optimization, as follows:

$$Sum_{\text{Octagonal Steiner tree}} = \prod \lim_{1\to\infty}([\frac{|ST1|}{R}]-u)+([\frac{|ST2|}{2R}]-2u)+([\frac{|ST3|}{3R}]-3u) \quad (7)$$

C. Definition of inflection point of octagonal Steiner tree

After the connection restoration of the robustness of Stana tree structure for the relay nodes of the octagonal

Stana tree grid, it is necessary to further define the inflection point of the octagonal Stana tree in combination with the previous algorithm, as follows:

Definition 1: assuming that the connection path between the source point and the end point of the octagonal Steiner tree changes, in the process of selecting the path inflection point, the additional inflection point is detected to obtain the optimal inflection point value, so as to ensure that the best inflection point is selected along the vertical path to the greatest extent[14].

Definition 2: select the inflection point from the 45 degree direction of the vertical line of the origin of the octagonal Steiner tree, and standardize the key mode.

Definition 3: adjust the xv-vx pattern from the vertical line of inflection point to the focus cluster along the 45 degree direction.

Based on the above definition, the routing transformation steps of Steiner tree are further optimized, as shown in the following table:

Table 2 steps of routing conversion for Steiner tree

Algorithm 1: octagonal Steiner tree algorithm based on culture gene:	Algorithm 2 local search algorithm
Traverse all nets N	For tracking all sides
Step1 uses prim algorithm to generate initial population	Four routing modes for traversal
Step2 traverses each individual in the population and calculates its fitness function value	Calculate the fitness value of the current routing mode
Step3 algorithm within the termination conditions	If the fitness value of the current routing mode is greater than the maximum fitness value
1) Cross operation based on maximal Union	Update the current maximum fitness value
2) Double mutation operation	Get the global optimal solution at the end of search
3) Local search	--
4) Calculate fitness function value	--
5) Select individuals for next iteration	--

Based on the above steps, we will further demonstrate the transition mode of steinshu walking line, as shown in the following figure:

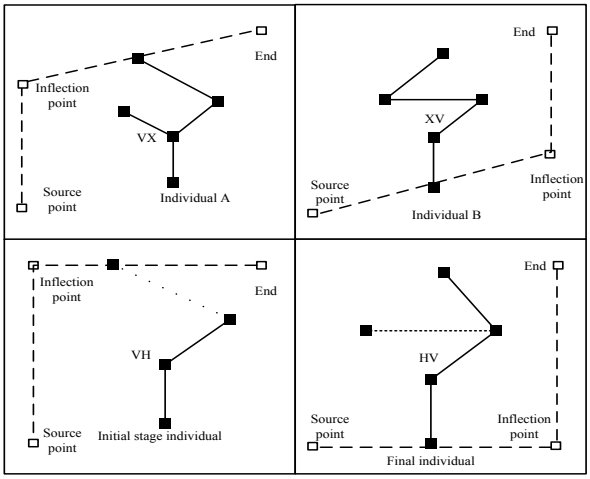

Figure 4 Steiner tree routing conversion mode

Based on the above pattern, the maximum Union in the branch of Steiner tree is processed by cross operation. In order to better accelerate convergence, the optimization principle of set maximum union is used to optimize the strategy of octagonal Steiner tree algorithm, and the node path is processed by multiple iterations to obtain the cross number value[15]. In order to better reduce the octagonal Steiner tree analysis algorithm, the limitations are analyzed, combined with The principle of double mutation operation is used to expand and search the whole data. The variation information is modified. Based on this, the octagonal Steiner tree is used to optimize the full connected topology of the shortest path layout node to obtain better individual sample values. The specific methods are as follows:

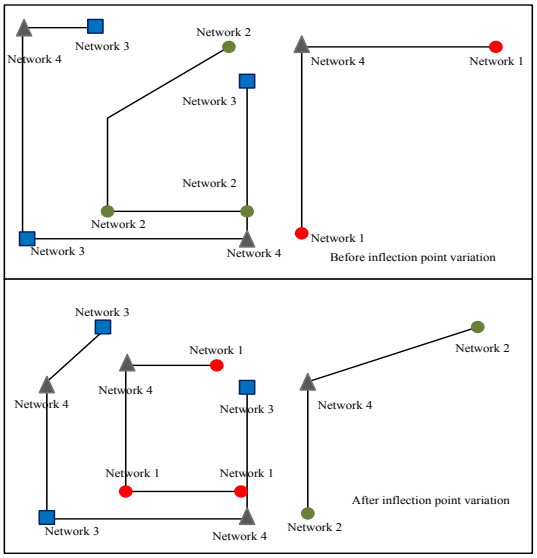

Figure 5 path layout and topology optimization

Based on the above steps, we can optimize the structure of octagonal Steiner tree better, ensure the collection and analysis of the numerical optimal solution of octagonal Steiner tree, and improve the data convergence effect to the greatest extent.

III. ANALYSIS OF EXPERIMENTAL RESULTS

In order to verify the effectiveness and superiority of the octagonal Steiner tree algorithm based on GPU acceleration, a comparative experiment is carried out. In order to ensure the experimental detection effect, you are responsible for standardizing the experimental environment. The experimental process is selected to use the windows 10 operating system, the data processor is is4500, and the main frequency of the device is 3.20 GHz and 128GB memory capacity, combined with C + + and Java language for programming, using Visual Studio 2017 to write programs to collect and record running values. Set the space deployment area of octagonal Steiner tree to a square area of 1500m × 1500m, and further standardize the experimental pretreatment strategy and relevant values, as shown in the table below:

Table 3 validation preprocessing strategy values

test case	Number of pins	Number of nodes	Pretreatment	Reduction rate /%
1	8	7	16.051	1.10
2	10	9	17.658	2.46
3	12	11	18.642	3.58
4	14	13	19.463	4.12
5	16	15	20.115	5.36
6	18	17	21.652	6.84
7	20	19	22.698	7.23

Based on the information in the above table, the distribution of relay nodes in octagonal Steiner tree is further detected. In the detection process, the higher the regional distribution density is, the better the data convergence effect is. Based on this, the average node distribution changes of triangle Steiner tree, quadrilateral Steiner tree and octagonal Steiner tree in the above experimental environment are compared to the scores Analysis, as shown in the figure below:

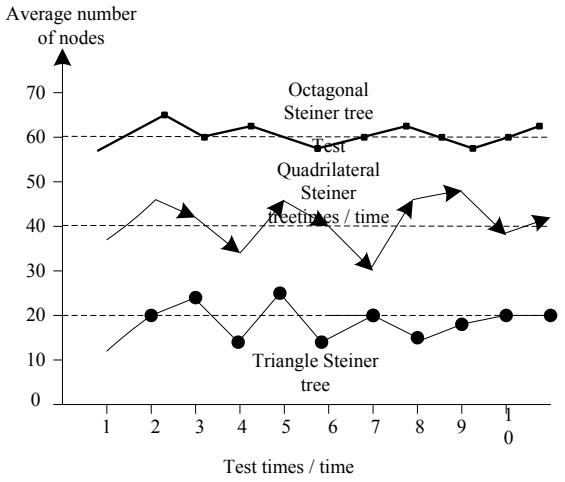

Figure 6 detection of node distribution of Steiner tree

Based on the above detection results, it can be seen that the GPU acceleration method is better for the detection of the average node distribution of octagonal Steiner tree. Among them, the average node distribution value of octagonal Steiner tree is relatively high, and its convergence is relatively high, which can better obtain the fast and accurate optimal solution of octagonal Steiner tree problem.

IV. CONCLUSION

The optimal solution of the octagonal Steiner tree problem is analyzed by GPU acceleration method. Through the connection optimization of Steiner tree nodes, the heuristic calculation, the node deployment structure and the specification of network connected relay nodes, the minimum spanning tree algorithm is optimized, and the inflection point of octagonal Steiner tree is defined, and the ultimate research goal is achieved.

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