Multiple comparison of green express aviation network path optimization research

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Abstract: This thesis make Courier industry aviation network path as the research object, the aviation network path optimization as analysis aspect. With multiple iterative Dijkstra algorithm for research tools, set up to aviation carbon emissions, transportation distance for many factors such as dimensions of green express aviation network path optimization model. Through the calculation of the optimal model, to reduce the flight time, shorten the transportation distance, eventually to reduce carbon emissions and green express aviation network path optimization purposes. Finally, use an example to proof the feasibility and advantages of the method.

Keywords: Aviation network; Green express; Carbon emissions; Multiple iterative

1 Introduction

With global warming issue getting serious, control carbon emissions became the key topic of atmospheric protection, according to related results of global research indicated, that air emissions occupy 2%-3% in total global greenhouse gas emissions, into the atmosphere every year about 700 million tons of carbon dioxide emissions, and by 2025, the number will achieve 1.488 billion tons[1]. Not long ago, a global climate conference was held in Copenhagen, the four largest aviation company called on to international airline emissions of carbon dioxide into the new agreement issues. And express industry in air transport application of rapid development, more increased was is heavy air energy consumption burden. In order to reduce the aviation carbon emissions, the fight against global warming, at November 19, 2008, the European Union decided to take the international air field into to EU emissions trading system (ETS)’s account, and at January 1, 2012 implementation, This measure will make aviation participants to pay expensive. According to the EU’s plan, carbon emissions in 2013 will down to 2% based on last year’s, it will put forward higher request for aviation carbon emissions.

According to research from other countries, the international air transport association said, the airlines and companies involve air transport business; have four strategies to solve the problem
of aviation emissions: (1) improved technology; (2) the efficient operation; (3) the infrastructure; (4) positive economic measures. A report by Tyndall center in Manchester University about aviation low carbon shows, by the end of 2011, the aviation industry will be in the range of carbon emissions to 355 MtCO2 between 284 MtCO2. Researches in our country about aviation low carbon is in the initial stage of exploration, the general research aspect for the macroscopic level of research. Lei Xia and Peng Yu (2011) consider that the development of the aviation industry in the macroscopic level with low carbon economy, and that the relevant macro conclusion, puts forward a low carbon economy in the airline industry development countermeasure; Hui Gong in the low carbon transport industry development of research, this paper use a new technology application, management changes, actively participate in the new regulations measures. To the airlines and companies involve air transport business, reduce air carbon emissions is an inevitable trend, but in the macroscopic level of the environmental background, at present, the research about the airline network path optimization is not much, and the express profession low carbon green aviation research is less.

From the above aviation carbon emissions present situation and the existing related research found, at present the aviation carbon emissions problem has become the global carbon emissions problem to be solved, but research from the network path optimization aspect is not much, research about express aviation carbon emissions less. This paper take express industry air transport as the research object, consider from aviation network optimization path analysis, from transportation carbon emissions, transportation distance, establish green express aviation network path optimization model, with multiple iterative Dijkstra algorithm for the research tool, research problems of express industry green aviation network path optimization, and reduce the plane running time, so as to reduce carbon emissions. To express aviation network of low carbon green and high timely effect, eventually reduce air transport carbon emissions burden, to reduce carbon emissions. The last make a Courier enterprise of air transport as an example, this paper proved that this method and the model of the feasibility and advantages.

2 Model illustration

2.1 Basic assumptions and symbols

In order to describe the model clearly, now introduce the definition of each symbol and its meaning as follows:
N: Represents the number of air terminals, namely analysis object has N aviation hubs currently, need to transport the goods to N numbers of air terminals.
X_{ij}: Represents the demand amounts of each air aviation hub to other aviation hub i and j represents the Numbers of each aviation hub.
T_{ij}: Represents the flight time of each aviation hub to other aviation hubs, the subscript i and j represents the Numbers of each aviation hub.
F_{ij}: Represents the carbon emissions of each aviation hub to other aviation hubs, the subscript i and j represents the Numbers of each aviation hub.
L_{ij}: Represents the distance between the each aviation hub to other aviation hub, the subscript i and j represents the Numbers of each aviation hub.
S: The speed of aircraft, is a fixed value constants.
H: The usage amount of the plane fuel.
Q: The plane's unit fuel consumption of the constant speed (Unit: L/KM).

According to the variable condition known:
\[ L_{ij} = T_{ij} \times S \]  
(1)
S for fixed value, greater than zero, so \( L_{ij} \) is a positive correlation function about \( T_{ij} \), namely flying the longer distance, the flight time is long;
According to Carbon emissions coefficient the Intergovernmental Panel on Climate Change (IPCC) made, exist:

CO2 emissions = Suggest emission coefficient * Intensity activity of emissions sources …… (2)

Among them, the intensity activity of emission source is to point to fuel usage H, namely:

CO2 emissions = Suggest emission coefficient * H ……………………………………… (3)

and H = Q * Lij………………………………………………………………………………… (4)

will (4) generation into (3), so

CO2 emissions = Suggest emission coefficient * Q * Lij………………………………… (5)

will (1) generation into (5), so

CO2 emissions = Suggest emission coefficient * Q * Tij * S………………………………(6)

According to Carbon emissions coefficient the Intergovernmental Panel on Climate Change (IPCC) made, the suggestion emission of coefficient aviation fuel is 2.39, make this data into (6), so

CO2 emissions = 2.39 * Q * Tij * S = Fij……………………………………………………… (7)

According to the known conditions, Q and S for a fixed value, greater than zero, so Fij is a positive correlation function about Tij, namely flying time to grow more, produce of carbon emissions is bigger. In other words, reduce flight distance can reduce flight time, then can reduce the aircraft in flight produce of carbon emissions.

The transport aircraft that have the same hardware conditions (fuel consumption, fuel combustion rate and flight speed the same), flight distance and flight time is proportional to the aviation hub of flight time between different. The plane flying time is shorter, the fuel consumption is less, the cost of the smaller, produce of carbon emissions is smaller. According to the reality, the amount of demand from each aviation hub come and back is different, the back and forth demand between every two hub of demand is different.

2.2 Algorithm model analysis

Dijkstra algorithm make by the Dutch computer scientists Dijkstra in 1959 and from a peak to the rest of the vertex shortest path algorithm, is the solution about the shortest path problem. Air transport network is a directed graph, in the first iteration of the supply demand conditions need to calculate a hub to the rest of the hub of the shortest path, which is used for the shortest path Dijkstra algorithm to calculate meets the requirement. So choose Dijkstra algorithm model establishment. This paper on the basis of Dijkstra algorithm, meet the needs of the business case considering flight time, flight carbon emissions factors such as multiple iterative, more deeply than a simple Dijkstra algorithm.

To ensure transport efficiency, the algorithm model regard demand as its first variables, every optimal route will go through the route that meet the maximum demand. Dijkstra algorithm is a method to calculate to calculate the optimal value. Before the calculation, we need to flip the data of demand as Dijkstra is a method to calculate the shortest path algorithm.

Dijkstra algorithm is used in every airline, when it go through the line add a points to the line, the same route go once is one more points. This makes the route and the relative difference between route, finally the conclusion shows the difference between each route, then obtain the final results.

In this algorithm model use the flight time between aviation hub as its second variables, between each aviation hub have different flight time, According to (7), the shorter flight time the lower of the cost. Will all aviation hub of flight time between Dijkstra algorithms with the final line again iteration. After the multiple iterative, choose the multiple supply demand and relatively low cost, then the algorithm is end. At this time, through the "meet demand--relative to save time and to optimize the path for the line-reduce carbon emissions” three steps, get the

1 Data sources from: Data from Intergovernmental Panel on Climate Change (IPCC) 2006
3 Algorithm design

1. Will the aviation hub for business demand (in and out into sum) from big to small sorting, establish processing a number line. Regard a 0 as the starting point of a number line. Select the largest business demand for data $X_{ij}$ as the end of a number line. And will end one half of data $(1/2 \times X_{ij})$ as the middle of a number line a number line.

2. Will more than a number line $1/2X_{ij}$ among the digital row among the right to a number line, among the number of less than a number line was a number line on the left. Use a number line between $1/2X_{ij}$ to the right of the $X_{ij}$ demand respectively between minus a number line, get a number $X'_{ij}$. Use a number line among the digital minus, as $1/2X_{ij} - X'_{ij}$, set to $H_{ij}$, this digital inevitable among less than a number line. Will this number are among the left to turn a number line; Use a number line between minus among the left side of the business model respectively demand($X_{ij}$), get $X'_{ij}$, use a number line with the Numbers. It means $1/2X_{ij} + X'_{ij}$, set to $H_{ij}$. This digital inevitable among more than a number line $1/2X_{ij}$, will this number to align to flip a number line. Among the right, as shown in figure 1 show:

![Figure 1 First deal with a number line](image1)

Will deal with the demand of a number line data and turn data apart, as shown in figure 2 shows:

![Figure 2 Final disposal of a number line](image2)

3. According to step 2 data processing results Dijkstra algorithm, use for the shortest route. No to figure $G=(V,E)$, the length of the side $E[i]$ that each for $w[i]$, find the vertex $V0$ to the others each point of the shortest path.

Dijkstra algorithm is described below:

About identification, Such as node identification for [20, 4]: The first figure said from the beginning node to the node number from the second distance, said the node node to start on the path of please a node in the Numbers.

Step 1: give node1 identification [0, S]. 0 mark node 1 to the distance to 0 is 0, S said node is the starting point.

Step 2: visit from node to node of the directly to 1, and gives a temporary logo.

Step 3: mark node determine from temporary with minimum distance node, and mark the node is the permanent marks. If all nodes are all permanent identifier, turn to step 5.

Step 4: the new permanent marker, the new logo marking began to examine the permanent logo cannot be directly to permanent marking node.

If the investigation for temporary mark node, node the new logo of permanent marking node
and the new logo distance value of permanent mark that point directly to the distance from the node value adding together. If its and less than the distance between temporarily logo point, is to determine the minimum distance value is the closest to the distance value.

If the node is the investigation of the node, not mark the new logo of permanent marking node with new mark distance value of permanent mark that point directly to the distance from the node value adding together. And as a contingent logo to the point. Return to step 3.

Step 5: The permanent logo is determined from node to node 1 each of the shortest, also identified the shortest route. The shortest route is determination by the pushing down theory.

4. According to the calculated step 3 of the shortest path route, multiple weighted processing.

<table>
<thead>
<tr>
<th>T1</th>
<th>T2</th>
<th>T3</th>
<th>T4</th>
<th>T5</th>
<th>T6</th>
<th>The max number</th>
</tr>
</thead>
<tbody>
<tr>
<td>t1</td>
<td>0</td>
<td>X12</td>
<td>X13</td>
<td>X14</td>
<td>X15</td>
<td>X16</td>
</tr>
<tr>
<td>t2</td>
<td>0</td>
<td>X22</td>
<td>X23</td>
<td>X24</td>
<td>X25</td>
<td>X26</td>
</tr>
<tr>
<td>t3</td>
<td>0</td>
<td>X32</td>
<td>X33</td>
<td>X34</td>
<td>X35</td>
<td>X36</td>
</tr>
<tr>
<td>t4</td>
<td>0</td>
<td>X42</td>
<td>X43</td>
<td>X44</td>
<td></td>
<td></td>
</tr>
<tr>
<td>t5</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X46</td>
</tr>
<tr>
<td>t6</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0</td>
</tr>
</tbody>
</table>

5. Will the route that the weight value according to the final, from big to small order. In step 4 of the model as an example, the result is as follow:


Every course be after once, plus one weights, multiple weighted. According to the above needs of the business lines, the results of multiple weighting as shown in figure 4:

5. Each aviation hub of flight time between the algorithms as the second variable model, all aviation hub flight between the times required for the list, as shown in chart 2:

Table 1: The shortest path between any two points

<table>
<thead>
<tr>
<th></th>
<th>V1</th>
<th>V2</th>
<th>V3</th>
<th>V4</th>
<th>V5</th>
<th>V6</th>
<th>The max number</th>
</tr>
</thead>
<tbody>
<tr>
<td>V1</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V2</td>
<td></td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V3</td>
<td></td>
<td></td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V4</td>
<td></td>
<td></td>
<td></td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>V6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

Figure 3 Shortest path chart

4. According to the calculated step 3 of the shortest path route, multiple weighted processing.

Figure 4 Multiple weighted the path after picture

Table 2 Aviation hub schedule

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>T_{AB}</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>T_{AC}</td>
<td></td>
<td>T_{BC}</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>T_{AD}</td>
<td></td>
<td>T_{BD}</td>
<td></td>
<td>T_{CD}</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
7. Will the time factor to consider in iterative Dijkstra algorithm after from the shortest path in the iterative again. If present the same path weights, get smaller time $T_{ij}$, the lines will once again sort, if TBD>TCE, The sort order for again after:

(1)A—B(2)B—C(3)C—E(4)D—E……

8. Sort of the map, after according to sort results mark. To the data of the results for example in part 7, first of all in the map mark "A—B", then mark “B—C”, mark “C—E”, finally mark “D—E”, until the mark all aviation hub, the algorithm so far end.

9. Through the Dijkstra algorithm for the shortest path, using line through The Times as weights, the first iterative of the shortest path, to select the optimal path; use the length of time as a second variables, the second iteration based on the results of the first iteration, select the optimal path of the optimal path.

Through multiple iterative in the shortest path, a selection of optimal solution, then the optimal solution in a selection of the shortest path in time, reduce $T_{ij}$, because $F_{ij} = 2.39 * Q * T_{ij} * S$, so to reduce carbon emissions $F_{ij}$, get the ultimate goal of green express aviation network path optimization, to save fuel costs, and at the same time to save cost objectives.

The final total carbon emissions for:

$$\sum_{ij} F_{ij} = 2.39 \sum_{ij} T_{ij}QS$$

### 4 Data simulation

1. According to a Express delivery enterprise, according to the results of the investigation, This express enterprise current aviation hub in Beijing, Shanghai, Chongqing, Shenyang, Chengdu, Wuxi, Weifang, Hangzhou, Shenzhen, Hong Kong ten cities. The amount of demand about each city is in the aviation, such as shown in table 3.

<table>
<thead>
<tr>
<th></th>
<th>010 Beijing</th>
<th>021 Shanghai</th>
<th>023 Chongqing</th>
<th>024 Shenyang</th>
<th>028 Chengdu</th>
<th>050 Wuxi</th>
<th>056 Weifang</th>
<th>051 Hangzhou</th>
<th>075 Shenzhen</th>
<th>085 Hong Kong</th>
</tr>
</thead>
<tbody>
<tr>
<td>010 Beijing</td>
<td>13585</td>
<td>2339</td>
<td>9219</td>
<td>4825</td>
<td>11433</td>
<td>11911</td>
<td>11978</td>
<td>21460</td>
<td>1799</td>
<td></td>
</tr>
<tr>
<td>021 Shanghai</td>
<td>20425</td>
<td>1974</td>
<td>6099</td>
<td>3810</td>
<td>8803</td>
<td>21265</td>
<td>5780</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>023 Chongqing</td>
<td>750</td>
<td>589</td>
<td>338</td>
<td>459</td>
<td>273</td>
<td>598</td>
<td>1766</td>
<td>53</td>
<td></td>
<td></td>
</tr>
<tr>
<td>024 Shenyang</td>
<td>6190</td>
<td>3073</td>
<td>519</td>
<td>839</td>
<td>2070</td>
<td>2207</td>
<td>2997</td>
<td>4188</td>
<td>735</td>
<td></td>
</tr>
<tr>
<td>028 Chengdu</td>
<td>3036</td>
<td>1059</td>
<td>604</td>
<td>1281</td>
<td>1057</td>
<td>1416</td>
<td>3628</td>
<td>157</td>
<td></td>
<td></td>
</tr>
<tr>
<td>050 Wuxi</td>
<td>16331</td>
<td>1697</td>
<td>5880</td>
<td>4807</td>
<td>8247</td>
<td>33784</td>
<td>4188</td>
<td>735</td>
<td></td>
<td></td>
</tr>
<tr>
<td>056 Weifang</td>
<td>9092</td>
<td>6419</td>
<td>784</td>
<td>2533</td>
<td>1699</td>
<td>5006</td>
<td>5672</td>
<td>12446</td>
<td>2829</td>
<td></td>
</tr>
<tr>
<td>051 Hangzhou</td>
<td>23857</td>
<td>4524</td>
<td>9332</td>
<td>9145</td>
<td>13788</td>
<td>58370</td>
<td>18852</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>075 Shenzhen</td>
<td>53138</td>
<td>44075</td>
<td>6925</td>
<td>14984</td>
<td>13746</td>
<td>48691</td>
<td>24409</td>
<td>63753</td>
<td></td>
<td></td>
</tr>
<tr>
<td>085 Hong Kong</td>
<td>2309</td>
<td>6347</td>
<td>142</td>
<td>858</td>
<td>210</td>
<td>6422</td>
<td>2125</td>
<td>9601</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: the above longitudinal for illnesses code (after dialling code for the three), transverse for
destination code (after dialling code for the three)

2. Data processing

According to the 1, all aviation hub of the demand for business data processing, purpose is the large number of conversion for small amounts, convenient calculation of the algorithm. Process as follows.

Will the aviation hub of the demand for business (in&out) the amount and quantity from big to small sorting, establish processing a number line. Regard a number 0 as the starting point of a number line. Select the maximum data demand for business, as the end of a number line, and will end one half of the data as a number line among the number line.

In the aviation hub, portfolio in the rankings finishing such as table 4:

<table>
<thead>
<tr>
<th>START……END</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shenzhen......Hangzhou</td>
<td>63753</td>
</tr>
<tr>
<td>Hangzhou ......Shenzhen</td>
<td>58370</td>
</tr>
<tr>
<td>Shenzhen......Beijing</td>
<td>53138</td>
</tr>
<tr>
<td>......</td>
<td>......</td>
</tr>
<tr>
<td>Chongqing......Hong Kong</td>
<td>53</td>
</tr>
</tbody>
</table>

(1)According to the table 4 ranking results, will more than a number line number row among the middle right, less than a number line among the number of a number line into the drain on the left a number line. That is 63753/2 = 31877 (take integer), 31877 as the middle of a number line.

(2)Use a number line on the right side of the middle demand among minus a middle number line, get a number, garnish with a number line minus the number. This digital inevitable among less than a number line, will this number are among the left to turn a number line; use a number line between minus among the left side of the business model respectively demand, garnish with a number line with the same number, this number will among more than a number line, will this number to align to flip a number line right.

For example: 31877-(59370-31877)=5384,31877-(53138-31877)=10616, (31877-53)+31877=63701, the last of the data processing a number line as shown in figure 5 shows:

![Figure 5 Prime number lines](image)

Will deal with the demand of a number line data and turn data apart,

![Figure 6 Final disposal of a number line](image)

Through the data processing, will be big demand for smaller Numbers, conversion of convenient operation after.

3. Time to handle

We base on the time, subject to all aviation hub of flight time for processing Table 5 for an Express delivery enterprise at present aviation hub of the flight schedule:
Table 5: Business needs flight schedule for the city

<table>
<thead>
<tr>
<th>Units: minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>010 Beijing</td>
</tr>
<tr>
<td>021 Shanghai</td>
</tr>
<tr>
<td>023 Chongqing</td>
</tr>
<tr>
<td>024 Shenyang</td>
</tr>
<tr>
<td>028 Chengdu</td>
</tr>
<tr>
<td>510 Wuxi</td>
</tr>
<tr>
<td>536 Weifang</td>
</tr>
<tr>
<td>571 Hangzhou</td>
</tr>
<tr>
<td>755 Shenzhen</td>
</tr>
<tr>
<td>852 Hong Kong</td>
</tr>
</tbody>
</table>

4. For the shortest path
According to the data processing results step 2 and 3 of the time step deal, and use Dijkstra algorithm for the shortest route.

5. Multiple iterative weighted
According to step 4 calculated, the shortest path route multiple weighted processing.
For example: Through calculation of the assumption that after the shortest path as shown in figure 7 shows.

![Figure 7 Shortest path chart](image)

The current business needs lines for:
(1) the Chengdu-Beijing-Hangzhou
(2) the Chengdu-Hangzhou
(3) the Chengdu-Hangzhou-Shenzhen
(4) Beijing-Hangzhou-Chengdu

Every course be go through, plus 1, on the multiple weighted. According to the above needs of the business lines, the result of the multiple weighting on after as shown in figure 8:

![Figure 8 Multiple weighting in the path of the diagram](image)

6. Ordering and mark
Will the route that the weight value according to the final, from big to small order. After sorting results for:
(1) Chengdu-Hangzhou(2)Beijing-Hangzhou(3) Hangzhou-Shenzhen
After sorting, in the map to sort results according to mark. First of all in the map out
"Chengdu--Hangzhou ", and then mark the “Hangzhou-Beijing ", to mark out" Hangzhou-Shenzhen "............. Until finish mark all aviation hubs.

So far, through the “aviation hub sure—the shortest path sure—multiple iterative—make line”, can assure an Express delivery company aviation network than the efficiency of the present situation, So that carbon emissions less than present situation, to achieve the goal of green express aviation network, and the cost less than the status quo.

Through calculation, the algorithm and the accuracy of practical application other related algorithm is more effective and more close to reality. This algorithm is easy to make the treatment efficiency, through the computer programming calculation relative to other related algorithm is more quickly.

5 Epilogue

Aviation carbon emissions is one of the major reasons for global warming, and express industry in air transport industry is more and more important, construction of the green express aviation network has certain forward-looking. Build the green express industry aviation network, not a single factors, but by many factors, various, multi-level network composed of express.

Before the related studies, most research mainly aims about the civil aviation industry or carbon emissions strategy problem in microscopically on, did not in on microscopic express profession construction of low carbon green the particularity of the aviation network to consider.

From the author’s point of view, this paper combining multiple iterative and a Dijkstra algorithm to aviation network planning, research aviation network optimal path, to get the goals about express aviation network of low carbon green, low cost and high efficiency. At the same time, the model is close to reality, has strong applicability.

Along with the raise of consciousness of environmental protection and low carbon green , the aviation industry participants to aviation network resources optimization and configuration also pay more and more attention to, this paper research the express profession green aviation network planning, can provide references about the aviation industry of express to build green aviation network planning, to some extent, reduce the express industry air transport carbon emissions, promotion, and optimization of the aviation network efficiency and reduce the cost. Of course the more draws close to the reality that makes the more complex algorithm, in \( \sum_{g} F_{g} = 2.39 \sum_{g} T_{g} QS \) (i>0, j>0), the algorithm considering the situation is Q and S fixed, carbon emissions only related to flight time, the reality of the Q and S may not fixed, because \( T_{g} S = L_{g} \), and the distance between the two hub \( L_{g} \) for setting value, this time the aviation carbon emissions only about fuel consumption Q, the greater the Q carbon emissions is high, the smaller the Q carbon emissions is less, the visible through the update technology reduce fuel consumption of the Q, is effective to reduce carbon emissions measures.

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