

Written Description

We claim:

1. A system for improving the flight safety, comprising:
a prediction component which predicts behaviors of an aircraft; and
an indication component which indicates adjustment of an operation of the aircraft to reduce the possibility of occurrence of abnormal flying behaviors.
2. The system of Claim 1, wherein the prediction module comprises:
model generation unit which constructs a data space based on two or more data dimensions of flying behaviors and generates a prediction model of flying behaviors according to searching conditions and constraint conditions;
data acquisition unit which acquires data of flying behaviors; and
prediction unit which searches high percentage regions of abnormal flying behaviors on the data space by using the prediction model of flying behaviors according to the data of flying behaviors.
3. The system according to Claim 1 further comprises a database, wherein the prediction unit acquires data of flying behaviors from the data acquisition unit or the database.
4. The system according to Claim 1, wherein the search of the prediction unit is performed in the region ready for search which is a part of the data space.

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5. The system according to Claim 4, wherein the searching conditions of the model generation unit are:

The higher the percentage of abnormal flying behaviors of the high percentage region is, the better, approaching 1 as much as possible;

The bigger the area of the high percentage region is, the better, approaching the entire region ready for search as much as possible;

The number of flights having abnormal behaviors contained in the high percentage region is as much as possible.

6. The system according to Claim 5, wherein the constraint condition of the model generation unit is: the number of flights having abnormal behaviors and/or total number of flights in the high percentage region exceeds a preset threshold.

7. The system according to Claim 6, wherein the constraint condition of the model generation unit further comprises: the percentage of abnormal flying behaviors in the high percentage region exceeds another threshold.

8. The system according to Claim 1, wherein the data acquisition unit determines the data of the data dimensions through adjustment by using the raw data of flying behaviors.

9. The system according to Claim 4, wherein the prediction unit further comprises:

searching module, traversing the region ready for search;

constraint solving module, judging whether the traversal results meet the constraint conditions; and

storing and ranking module, storing all traversal results which meet the conditions, and ranking on an overall basis, and outputting high percentage regions of abnormal flying time according to the overall ranking result.

10. The system according to Claim 9, wherein the searching unit searches the region ready for search on the entire data space.

11. The system according to Claim 10, wherein the searching unit searches the block whose percentage of abnormal flying behaviors exceeds the first threshold, and marks the connected blocks.

12. The system according to Claim 11, wherein the searching unit further searches the

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region formed by blocks whose percentage of abnormal flying behaviors exceeds the first threshold.

13. The system according to Claim 12, wherein the constraint solving module solves the searching conditions for the traversal results of each region, ranks single goal value and selects the minimum value as the optimal value of the region.
14. The system according to Claim 13, wherein the constraint solving module judges the traversal with minimum value according to the constraint conditions.
15. The system according to Claim 14, wherein the constraint solving module judges the traversal with minimum value according to the constraint conditions.
16. The system according to Claim 9, wherein the storing and ranking module calculates and ranks the value of each searching condition for all regions traversed.
17. The system according to Claim 16, wherein the storing and ranking module calculates the overall rank of all traversed blocks according to the value of each searching condition of all regions traversed.
18. A method of improving of the flight safety, comprising:

predicting behaviors of an aircraft; and

indicating adjustment of an operation of the aircraft to reduce possibility of occurrence of abnormal flying behaviors.
19. The method of Claim 18, wherein predicting behaviors of an aircraft comprising:

constructing a data space based on two or more data dimensions of flying behaviors and generating a prediction model of flying behaviors according to the searching conditions and constraint conditions;

acquiring data of flying behaviors; and

Searching high percentage regions of abnormal flying behaviors on the data space by using the prediction model of flying behaviors according to the data of flying behaviors.
20. The method according to Claim 19, the searching is performed in the region ready for search which is a part of the data space.
21. The method according to Claim 20, wherein the searching conditions are:

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- the higher the percentage of abnormal flying behaviors in the high percentage region is, the better, approaching 1 as much as possible;
- the bigger the area of the high percentage region is, the better, approaching the entire region ready for search as much as possible;
- the number of flights having abnormal flying behaviors contained in the high percentage region is as much as possible.
22. The method according to Claim 21, wherein the constraint condition is: the number of flights having abnormal behaviors and/or the total number of flights in the high percentage region exceeds a preset threshold.
23. The method according to Claim 22, wherein the constraint condition further comprises: the percentage of abnormal flying behaviors in the high percentage region exceeds another threshold.
24. The method according to Claim 19, further comprises determining the data of the data dimensions through adjustment by using the raw data of flying behaviors.
25. The method according to Claim 21, further comprises:
- traversing the region ready for search;
 - judging whether the traversal results meet the constraint condition; and
 - storing all traversal results which meet the conditions and ranking on an overall basis; and then outputting high percentage regions with abnormal flying time according to the overall ranking results.
26. The method according to Claim 25, further comprises searching the region ready for search in the entire data space.
27. The method according to Claim 26, further comprises searching the block whose percentage of abnormal flying behaviors exceeds the first threshold and marking the connected blocks.
28. The method according to Claim 27, further comprises searching the region formed by blocks whose percentage of abnormal flying behaviors exceeds the first threshold.
29. The method according to Claim 28, further comprises solving the searching condition for the traversal results of each region, ranking single goal value, and selecting the traversal

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with minimum value as the optimal value of the region.

30. The method according to Claim 29, further comprises judging the traversal with minimum value according to the constraint conditions.
31. The method according to Claim 30, further comprises judging the traversal with minimum value according to the constraint conditions.
32. The method according to Claim 25, further comprises calculating and ranking the value of each searching condition of all regions traversed.
33. The method according to Claim 32, further comprises calculating the overall rank of all the blocks traversed according to the value of each searching condition of all regions traversed.

We claim:

1. A system for improving the flight safety, comprising:
 - a prediction module comprising circuitry configured to predict behaviors of an aircraft, the prediction module further comprises:
 - a model generation unit comprising circuitry configured to construct a data space based on two or more data dimensions of flying behaviors and generates a prediction model of flying behaviors according to searching conditions and constraint conditions,
 - a data acquisition unit comprising circuitry configured to acquire data of flying behaviors,; and
 - a prediction unit comprising circuitry configured to search high percentage regions of abnormal flying behaviors according to the data of flying behaviors; and
 - an indication module comprising circuitry configured to indicate an adjustment of an operation of the aircraft to reduce the possibility of occurrence of abnormal flying behaviors,
 - wherein the search of the prediction unit is performed in the region ready for search which is included in the data space,
 - wherein the searching conditions of the model generation unit maximize the percentage of abnormal flying behaviors of the high percentage region, the area of the high percentage region is approaching the entire region ready for search, and the number of flights having abnormal behaviors contained in the high percentage region, and
 - wherein the constraint condition of the model generation unit includes at least one of the number of flights having abnormal behaviors and total number of flights in the high percentage region exceeds a preset threshold.
2. The system according to Claim 1 further comprises a database, wherein the prediction unit acquires data of flying behaviors from the data acquisition unit or the database.
3. The system according to Claim 1, wherein the constraint condition of the model generation unit further comprises: the percentage of abnormal flying behaviors in the high percentage region exceeds another threshold.

4. The system according to Claim 1, wherein the data acquisition unit determines the data of the data dimensions through adjustment by using the raw data of flying behaviors.
5. The system according to Claim 1, wherein the prediction unit further comprises:
 - searching module, traversing the region ready for search;
 - constraint solving module, judging whether the traversal results meet the constraint conditions; and
 - storing and ranking module, storing all traversal results which meet the conditions, and ranking on an overall basis, and outputting high percentage regions of abnormal flying time according to the overall ranking result.
6. The system according to Claim 5, wherein the searching unit searches the region ready for search on the entire data space.
7. The system according to Claim 6, wherein the searching unit searches the block whose percentage of abnormal flying behaviors exceeds the first threshold, and marks the connected blocks.
8. The system according to Claim 7, wherein the searching unit further searches the region formed by blocks whose percentage of abnormal flying behaviors exceeds the first threshold.
9. The system according to Claim 8, wherein the constraint solving module solves the searching conditions for the traversal results of each region, ranks single goal value and selects the minimum value as the optimal value of the region.
10. The system according to Claim 9, wherein the constraint solving module judges the traversal with minimum value according to the constraint conditions.
11. The system according to Claim 10, wherein the constraint solving module judges the traversal with minimum value according to the constraint conditions.

12. The system according to Claim 5, wherein the storing and ranking module calculates and ranks the value of each searching condition for all regions traversed.
13. The system according to Claim 12, wherein the storing and ranking module calculates the overall rank of all traversed blocks according to the value of each searching condition of all regions traversed.
14. A method of improving of the flight safety, comprising:
 - predicting behaviors of an aircraft, comprising:
 - constructing a data space based on two or more data dimensions of flying behaviors and generating a prediction model of flying behaviors according to the searching conditions and constraint conditions,
 - acquiring data of flying behaviors, and
 - searching high percentage regions of abnormal flying behaviors on the data space by using the prediction model of flying behaviors according to the data of flying behaviors; and
 - indicating adjustment of an operation of the aircraft to reduce possibility of occurrence of abnormal flying behaviors,
 - wherein the searching is performed in the region ready for search that is a part of the data space,
 - wherein the searching conditions maximize the percentage of abnormal flying behaviors in the high percentage region, the area of the high percentage region is by approaching the entire region ready for search, and the number of flights having abnormal flying behaviors contained in the high percentage region, and
 - wherein the constraint condition includes at least one of the number of flights having abnormal behaviors and the total number of flights in the high percentage region exceeds a preset threshold.
15. The method according to Claim 14, wherein the constraint condition further comprises: the percentage of abnormal flying behaviors in the high percentage region exceeds another threshold.

16. The method according to Claim 14, further comprises determining the data of the data dimensions through adjustment by using the raw data of flying behaviors.
17. The method according to Claim 14, further comprises:
traversing the region ready for search;
judging whether the traversal results meet the constraint condition; and
storing all traversal results which meet the conditions and ranking on an overall basis;
and then outputting high percentage regions with abnormal flying time according to the overall ranking results.
18. The method according to Claim 17, further comprises searching the region ready for search in the entire data space.
19. The method according to Claim 18, further comprises searching the block whose percentage of abnormal flying behaviors exceeds the first threshold and marking the connected blocks.
20. The method according to Claim 19, further comprises searching the region formed by blocks whose percentage of abnormal flying behaviors exceeds the first threshold.
21. The method according to Claim 20, further comprises solving the searching condition for the traversal results of each region, ranking single goal value, and selecting the traversal with minimum value as the optimal value of the region.
22. The method according to Claim 21, further comprises judging the traversal with minimum value according to the constraint conditions.
23. The method according to Claim 17, further comprises calculating and ranking the value of each searching condition of all regions traversed.
24. The method according to Claim 23, further comprises calculating the overall rank of all the blocks traversed according to the value of each searching condition of all regions traversed.