

SUMMARY

The disclosed examples are described in detail below with reference to the accompanying drawing figures listed below. The following summary is provided to illustrate some examples disclosed herein. It is not meant, however, to limit all examples to any particular configuration or sequence of operations.

Some aspects and implementations disclosed herein are directed to methods for generating a sensor driven optimized (or improved) maintenance program (SDOMP). An example method comprises: receiving a first maintenance plan for an apparatus type, the first maintenance plan defining maintenance tasks for the apparatus type and defining intervals at which the maintenance tasks are to be performed; receiving historical sensor data ~~(including sensor alert data)~~, historical scheduled maintenance data, historical unscheduled maintenance data, ~~and documentation linking sensor alerts with maintenance tasks~~; correlating the historical sensor data with the historical scheduled maintenance data and the historical unscheduled maintenance data to determine a predictive value of the sensor data, the predictive value providing a mapping of sensor alerts and the maintenance tasks; receiving one or more maintenance improvement objectives of an operator of an apparatus of the apparatus type; and based at least on the predictive value of the sensor data and the maintenance improvement objectives, generating the SDOMP, the generated SDOMP comprising an adjusted one of the defined intervals.

Systems and methods for generating an SDOMP are also provided. A first maintenance plan for an apparatus type is received; the first maintenance plan defining maintenance tasks for the apparatus type and defining intervals at which the maintenance tasks are to be performed. Historical sensor data, historical scheduled maintenance data, and

historical unscheduled maintenance data are received and correlated to determine a predictive value of the sensor data. The predictive value provides a mapping of sensor alerts and the maintenance tasks. One or more maintenance improvement objectives of an operator of an apparatus of the apparatus type are received, and the SDOMP is generated, based at least on the predictive value of the sensor data and the maintenance improvement objectives. The SDOMP includes an adjusted one of the defined intervals.

BRIEF DESCRIPTION OF THE DRAWINGS

The disclosed examples are described in detail below with reference to the accompanying drawing figures listed below:

FIG. 1 is a block diagram of apparatus production and service methodology.

FIG. 2 is a block diagram of an apparatus 200 for various aspects of the disclosure.

FIG. 3 is a schematic perspective view of a particular flying module 201.

FIG. 4 is a block diagram of an implementation of a memory area 410 for a computing device 400.

FIG. 5 illustrates overlapping probability density curves and a threshold that drives probability of detection and probability of false alarm values.

FIG. 6 illustrates a cumulative distribution function (CDF) for a probability of detecting a condition requiring a repair or other maintenance action.

FIG. 7 illustrates a changed threshold for the CDF curve of FIG. 6.

FIG. 8 illustrates graphically how the changed threshold of FIG. 7 is determined.

FIG. 9 is a block diagram of an implementation of a process flow for implementing aspects of the disclosure.

FIG. 10 is an implementation alert display.

CLAIMS

~~WHAT IS CLAIMED IS:~~

1. A method for generating a sensor driven optimized maintenance program (SDOMP), the method comprising:

receiving a first maintenance plan for an apparatus type ~~(1602)~~, the first maintenance plan defining maintenance tasks for the apparatus type and defining intervals at which the maintenance tasks are to be performed;

receiving historical sensor data ~~(1604)~~ including sensor alert data, historical scheduled maintenance data ~~(1606)~~, and historical unscheduled maintenance data ~~(1608)~~, and ~~documentation linking sensor alerts with the maintenance tasks;~~

correlating ~~(1610)~~ the historical sensor data with the historical scheduled maintenance data and the historical unscheduled maintenance data to determine a predictive value of the sensor data, the predictive value providing a mapping of sensor alerts and the maintenance tasks;

receiving one or more maintenance improvement objectives ~~(418)~~ of an operator of an apparatus of the apparatus type; and

based at least on the predictive value of the sensor data and the maintenance improvement objectives, generating the SDOMP ~~(1618)~~, the generated SDOMP comprising an adjusted one of the defined intervals.

2. The method of Claim 1, wherein the first maintenance plan comprises an approved maintenance plan ~~(414)~~.

3. The method of Claim 1 or 2, wherein the apparatus type is an airplane ~~(201)~~.

4. The method of any one of Claims 1 to 3, wherein the sensor data comprises apparatus health management (AHM) alert data ~~(422)~~, and wherein the AHM alert data comprises at least one data type selected from the list consisting of:

tire pressure, oxygen pressure, hydraulic fluid, auxiliary power unit (APU) oil level, and engine oil level.

5. The method of any one of Claims 1 to 4, wherein determining the predictive value of the sensor data ~~(428)~~ comprises determining a probability that a sensor alert corresponds to a non-routine finding.

6. The method of any one of Claims 1 to 5, wherein the one or more maintenance improvement objectives ~~(418)~~ of the operator comprises an acceptable risk level.

7. The method of any one of Claims 1 to 6, wherein generating the SDOMP ~~(1618)~~ based at least on the predictive value of the sensor data and the maintenance improvement objectives comprises escalating an inspection interval when the predictive value of the sensor data meets a threshold.

8. The method of any one of Claims 1 to 7, further comprising:

receiving an operation history for the apparatus ~~(1612)~~, and

wherein generating the SDOMP ~~(1618)~~ further comprises generating the SDOMP based at least on the operation history for the apparatus.

9. The method of any one of Claims 1 to 8, further comprising:

determining an end date to the SDOMP ~~(434)~~, and

wherein generating the SDOMP ~~(1618)~~ further comprises generating the SDOMP based at least on the end date.

10. The method of any one of Claim 1 to 9, further comprising:

determining a net benefit of adjusting an interval ~~(1614)~~, and

wherein generating the SDOMP ~~(1618)~~ further comprises generating the SDOMP based at least on a cost associated with the maintenance tasks.

11. A system for generating a sensor driven optimized maintenance program (SDOMP), the system comprising:

one or more processors ~~(402)~~; and

a memory area ~~(410)~~ storing an analysis component ~~(428)~~, that when executed by the one or more processors, cause the one or more processors to perform operations comprising:

receiving a first maintenance plan ~~(1602)~~ for an apparatus type, the first maintenance plan defining maintenance tasks for the apparatus type and defining intervals at which the maintenance tasks are to be performed;

receiving historical sensor data ~~(1604)~~ including sensor alert data, historical scheduled maintenance data ~~(1606)~~, and historical unscheduled maintenance data ~~(1608)~~, and ~~documentation linking sensor alerts with the maintenance tasks;~~

correlating ~~(1610)~~ the historical sensor data with the historical scheduled maintenance data and the historical unscheduled maintenance data to determine a predictive value of the sensor data, the predictive value providing a mapping of sensor alerts and the maintenance tasks;

receiving one or more maintenance improvement objectives ~~(418)~~ of an operator of an apparatus of the apparatus type; and

based at least on the predictive value of the sensor data and the maintenance improvement objectives, generating the SDOMP ~~(1618)~~, the generated SDOMP comprising an adjusted one of the defined intervals.

12. The system of Claim 11, wherein the first maintenance plan comprises an approved maintenance plan ~~(414)~~.
13. The system of Claim 11 or 12, wherein the apparatus type is an airplane ~~(201)~~.
14. The system of any one of Claims 11 to 13, wherein the sensor data comprises apparatus health management (AHM) alert data ~~(422)~~, and wherein the AHM alert data comprises at least one data type selected from the list consisting of:
- tire pressure, oxygen pressure, hydraulic fluid, auxiliary power unit (APU) oil level, and engine oil level.
15. The system of any one of Claims 11 to 14, wherein determining the predictive value of the sensor data ~~(428)~~ comprises determining a probability that a sensor alert corresponds to a non-routine finding.
16. The system of any one of Claims 11 to 15, wherein the one or more maintenance improvement objectives ~~(418)~~ of the operator comprises an acceptable risk level.
17. The system of any one of Claims 11 to 16, wherein generating the SDOMP ~~(1618)~~ based at least on the predictive value of the sensor data and the maintenance improvement objectives comprises escalating an inspection interval when the predictive value of the sensor data meets a threshold.
18. The system of any one of Claims 11 to 17, wherein the operations further comprise:
- receiving an operation history for the apparatus ~~(1612)~~, and
- wherein generating the SDOMP ~~(1618)~~ further comprises generating the SDOMP based at least on the operation history for the apparatus.

19. The system of any one of Claims 11 to 18, wherein the operations further comprise:
determining an end date to the SDOMP ~~(434)~~, and

wherein generating the SDOMP ~~(1618)~~ further comprises generating the SDOMP
based at least on the end date.

20. The system of any one of Claims 11 to 19, wherein the operations further comprise:
determining a net benefit of adjusting an interval ~~(1614)~~, and

wherein generating the SDOMP ~~(1618)~~ further comprises generating the SDOMP
based at least on a cost associated with the maintenance tasks.