We claim:

1. A method for monitoring a malfunction of an APU turbine vane fracture and rotation shaft jam, comprising:

acquiring, by a message acquiring unit, APU messages at multiple time points within a period;

obtaining, by a message analyzing unit, operation parameters of the APU according to the APU messages, the operation parameters of the APU including at least a start time STA;

calculating, by a message analyzing unit, the average value AVG and the deviation index δ of the start time STA within the period;

determining, by a malfunction monitoring unit, a circumstance of the APU turbine vane fracture and rotation shaft jam is in stable phase, decline phase or malfunction phase according to the deviation index δ.

2. According to the method of claim 1, wherein the step of determining the circumstances of APU turbine vane fracture and rotor shaft jam is in stable phase, decline phase or malfunction phase comprises:

in response to the deviation index δ is less than a threshold value of decline phase, determining, by the malfunction monitoring unit, the circumstances of APU turbine vane fracture and rotor shaft jam is in stable phase;

in response to the deviation index δ is greater than the threshold value of decline phase and less than a threshold value of malfunction, determining, by the malfunction monitoring unit, the circumstances of APU turbine vane fracture and rotor shaft jam is in decline phase; and

in response to the deviation index δ is greater than the threshold value malfunction, determining, by the malfunction monitoring unit, the circumstances of APU turbine vane fracture and rotor shaft jam is in malfunction phase.

3. According to the method of claim 2, further comprises:

determining, by the malfunction monitoring unit, the deviation index δ when the circumstances of APU turbine vane fracture and rotor shaft jam is in stable phase;

wherein the threshold value of decline is around 2 times than the deviation index δ, and the threshold value of malfunction is around 6 times than a stable deviation index.

4. According to the method of claim 2, wherein, the decline phase further comprises a serious decline phase, and a threshold value of the serious decline phase is between the threshold value of decline phase and the threshold value of malfunction phase, in response to the deviation index δ is greater than the threshold value of the serious decline phase and less than the threshold value of the malfunction phase, determining, by the malfunction monitoring unit, the circumstances of APU turbine vane fracture and rotor shaft jam is in serious decline phase, the threshold value of the serious decline phase is around 4 times than the stable deviation index δ.

5. According to the method of claim 1, wherein the time period is about 5-10 days in the case when 2 or 3 time points are measured per day.

6. According to the method of claim 1, wherein about 10-40 APU messages are obtained within the time period.

7. According to the method of claim 1, further comprises:

Obtaining, by a message analyzing unit, the start time STA on a next time point by updating the APU message at the next time point;

in response to STA_{next} is greater than AVG $+n\delta$ or less than AVG- $n\delta$, determining, by the malfunction monitoring unit, whether STA_{next+1} obtained according to the further next message related to APU is greater than AVG$+n\delta$ or less than AVG-$n\delta$; and

in response to the start time STA obtained according to the message related to APU is greater than AVG$+n\delta$ or less than AVG-$n\delta$ continuously and exceeding a predetermined number Z, issuing, by the malfunction monitoring unit, a warning,

wherein the value of n is determined by a control strategy.

8. According to the method of claim 7, in response to the start time STA obtained according to the message related to APU is between AVG$+n\delta$ or less than average value AVG-$n\delta$, recalculating, by the message analyzing unit, the average value AVG and deviation index δ of the start time STA.

9. According to the method of claim 7, in response to the start time STA obtained according to the message related to APU is greater than AVG+nδ or less than AVG-nδ continuously and exceeding the predetermined number Z, recalculating, by the message analyzing unit, the average value AVG and deviation index δ of the start time STA.

10. According to the method of claim 1, wherein the deviation index δ is the standard deviation of the start time STA.

11. According to the method of claim 7, wherein the value of n is 2 or 3.

12. According to the method of claim 7, further comprises:

in response to the start time STA obtained according to the message related to APU is greater than AVG+nδ or less than AVG-nδ continuously and exceeding the predetermined number Z, issuing, by the malfunction monitoring unit, the warning.

13. According to the method of claim 7, wherein the value of Z is 3-5.

14. According to the method of claim 1, the method further comprises: in response to whether a highest exhaust gas temperature on start EGTP reaches a redline temperature, issuing, by the malfunction monitoring unit, a warning of the malfunction of the turbine vane fracture and rotation shaft jam.

15. According to the method of claim 14, the method further comprises: in response to whether a number of proportion in APU (NPA) reaches or closes to a predetermined threshold value of NPA when EGT is at its peak on start, issuing, by the malfunction monitoring unit, the warning of the malfunction of the turbine vane fracture and rotor shaft jam, wherein the predetermined threshold value of NPA is 35-40%, wherein the NPA is the percent of the rotation speed of the turbine when the exhaust temperature (EGT) of APU reaches its peak value in the start stage of APU with respect to the constant rotation speed in normal operation of APU (% RPM/APU RPM).

16. According to the method of claim 15, wherein in response to an increase of the standard of EGTP and NPA, issuing, by the malfunction monitoring unit, the warning of the malfunction of the turbine vane fracture and rotation shaft jam.

17. According to the method of claim 15, the method further comprises: in response to an exhaust gas temperature EGT close to the redline temperature or whether an angle of an inlet guide vane IGV appears as an upward jump, issuing, by the malfunction monitoring unit, the warning of the malfunction of APU turbine vane fracture and rotation shaft jam.

18. According to the method of claim 1, wherein the method further comprises:
obtaining, by the message analyzing unit, history data of the start time STA; and

determining, by the malfunction monitoring unit, whether the start time STA exhibits gradual increase, gradual regular, and then discrete.

19. A device for monitoring a malfunction of an airborne auxiliary power unit APU turbine vane fracture and rotation shaft jam, comprises:
a message acquiring unit, which acquires APU messages within a time period;

a message analyzing unit, which analyses required APU operation data at least comprising a start time STA and calculates average value AVG and deviation index δ of the start time STA within the time period; and

a malfunction monitoring unit, which determines circumstances of APU turbine vane fracture and rotor shaft jam is in stable phase, decline phase or malfunction phase according to the deviation index δ.

20. A device for monitoring a malfunction of an airborne auxiliary power unit APU turbine vane fracture and rotation shaft jam, comprises:

a processor; and

a memory coupled to the processor, which stores

computer-readable codes;

the computer-readable codes run in the processor to execute the following steps:

acquiring APU messages at multiple time points within a time period;

obtaining operation parameters of the APU according to the APU message, the operation parameters at least comprises start time STA;

calculating average value AVG and deviation index δ of the start time STA within the time period; and

determining that circumstances of APU turbine vane fracture and rotor shaft jam is in stable phase, decline phase, serious decline phase or malfunction phase according to the deviation index δ.