We claim:

1. An aircraft jitter detection system, comprising:

a jitter detection apparatus, which detects accelerations of pitch and yaw of the aircraft;

a data acquisition apparatus, which obtains accelerations in two directions detected by the jitter detection apparatus; and

a jitter determination apparatus, which extracts frequency spectrum and energy information of the jitter according to the accelerations in two directions obtained by the data acquisition apparatus, and determines whether the aircraft jitters.

2. The system of Claim 1, further comprises: a mode comparison apparatus, which estimates a component where jitter might occur by comparing frequency and direction information of the aircraft jitter with jitters caused by already-known jitter sources.

3. The system of Claim 1, wherein the jitter detection apparatus comprises an inertial navigation computer of aircraft, an inertial navigation platform or an accelerometer with a three-axis gravity acceleration sensor

4. The system of Claim 1, wherein the data acquisition apparatus comprises DMU, QAR or FDR of the aircraft, or a high frequency sampling independent hardware apparatus.

5. The system of Claim 1 further comprises a message generation apparatus and a communication apparatus, the message generation apparatus generating a jitter data message according to the acceleration data in two directions obtained by the data acquisition apparatus; the communication apparatus transmitting the jitter data message to the jitter determination apparatus on the ground via an air-ground data link system.

6. The system of Claim 1 further comprises a jitter recording starting

apparatus.

7. The system of Claim 1, wherein the jitter detection apparatus, the data acquisition apparatus or the message generation apparatus initiates detection of jitter during the climb or cruise stage of the aircraft.

8. The system of Claim 7, wherein at the time when the aircraft starts to clime or around 10 seconds or 20 seconds after the aircraft starts to climb, the jitter detection apparatus, the data acquisition apparatus or the message generation apparatus initiates detection of jitter; or when the aircraft starts to climb at a speed larger than 260 knots, the jitter detection apparatus, the data acquisition apparatus or the message generation apparatus initiates detection of jitter; or when the aircraft is in a steady-state cruise condition or around 40 seconds after the aircraft is in a steady-state cruise condition, the jitter detection apparatus, the data acquisition apparatus or the message generation apparatus initiates detection of jitter.

9. The system of Claim 1, wherein the jitter determination apparatus determines frequency spectrum and energy information of the jitter according to the acceleration in two directions within a time period obtained by the data acquisition apparatus.

10. The system of Claim 9, wherein the jitter determination apparatus processes acceleration data in two directions of pitch and yaw of the aircraft within a time period via Fourier Transform, and obtains spectrum distribution of the jitter.

11. The system of Claim 9, wherein the jitter determination apparatus processes acceleration data in two directions of pitch and yaw of the aircraft within a time period via Smooth-Pseudo Wigner-ville Distribution and/or Wavelet Transform, and obtains energy distribution of

the jitter.

12. The system of Claim 11, wherein the jitter determination apparatus determines the occurrence of a jitter when the jitter energy exceeds a preset threshold value.

13. The system of Claim 12, wherein the preset threshold value is energy density of the jitter larger than 150db, and amplitude of the jitter after being processed via Fourier Transform larger than 0.0003 $m^2/s/Hz$.

14. The system of Claim 2, wherein the mode comparison apparatus determines source of the jitter in combination with location information of the jitter.

15. A method for detecting an aircraft jitter, comprising:

detecting accelerations of pitch and yaw of the aircraft;

obtaining accelerations in two directions detected by the jitter detection apparatus; and

extracting frequency spectrum and energy information of the jitter according to the accelerations in two directions obtained by the data acquisition apparatus, and determining whether the aircraft jitters.

16. The method of Claim 15 further comprises estimating a component where jitter occurs by comparing frequency and direction information of the aircraft jitter with jitters caused by already-known jitter sources.

17. The method of Claim 15 further comprises generating a jitter data message according to acceleration data in two directions of the aircraft obtained by the data acquisition apparatus.

18. The method of Claim 17 further comprises transmitting the jitter data message to the ground via an air-ground data link system.

19. The method of Claim 15 further comprises initiating detection of jitter during the climb or cruise stage of the aircraft.

20. The method of Claim 19, wherein at the time when the aircraft starts to climb or around 10 seconds or 20 seconds after the aircraft starts to climb, initiating detection of jitter; when the aircraft starts to climb at a speed larger than 260 knots, initiating detection of jitter; or, when the aircraft is in a steady-state cruise condition or around 40 seconds after the aircraft is in a steady-state cruise condition, initiating detection of jitter.

21. The method of Claim 15 further comprises processing acceleration data in two directions of pitch and yaw of the aircraft within a certain time period via Fourier Transform, and obtaining spectrum distribution of the jitter.

22. The method of Claim 15 further comprises processing acceleration data in two directions of pitch and yaw of the aircraft within a certain time period via Smooth-Pseudo Wigner-ville Distribution and/or Wavelet Transform, and obtaining energy distribution of the jitter.

23. The method of Claim 22 further comprises determining the occurrence of jitter when the jitter energy exceeds a preset threshold value.

24. The method of Claim 23, wherein the preset threshold value is energy density of the jitter larger than 150db, and amplitude of the jitter after being processed via Fourier Transform larger than 0.0003 $m^2/s/Hz$.

25. The method of Claim 16 further comprises determining source of the jitter in combination with location information of the jitter.

26. A method for maintaining malfunction of an aircraft jitter, comprising:

obtaining jitter data, wherein the jitter data comprise accelerations in two directions of pitch and yaw of the aircraft within a certain time period; and

obtaining frequency spectrum and energy distribution information of the jitter, and determining whether a jitter actually occurs.

27. The method of Claim 26 further comprises determining a possible source of the jitter malfunction according to frequency and direction of the jitter.

28. The method of Claim 26 further comprises determining a possible source of the jitter malfunction according to frequency and direction of the jitter as well as location information of the jitter.

29. The method of Claim 28 further comprises maintaining jitter malfunction of the aircraft according to the resulting possible source of the jitter malfunction.

30. A method for maintaining an aircraft comprising:

building a system for detecting an aircraft jitter as described in Claims 1-14, or utilizing a method for detecting an aircraft jitter as described in Claims 15-25; and

extending time interval for replacing a component of the aircraft where a jitter might occur.

31. The method of Claim 31, wherein the component where a jitter might occur is one or more selected from the following group: rod end of the rudder, actuating cylinder of the rudder and rod end of the elevator.

We claim:

1. An aircraft jitter detection system for detecting jitter in the form of unstable aircraft structural oscillations, comprising:

a jitter detection apparatus, arranged to detect accelerations of pitch and yaw of the aircraft;

a data acquisition apparatus, arranged to obtain accelerations in two directions detected by the jitter detection apparatus; and

a jitter determination apparatus, arranged to extract frequency spectrum and energy information of the jitter according to the accelerations in two directions obtained by the data acquisition apparatus, and

compare the extracted frequency spectrum with a threshold value and the energy information with another threshold value to determine whether the aircraft jitters;

wherein the jitter detection apparatus, the data acquisition apparatus or the message generation apparatus initiates detection of jitter during the climb or cruise stage of the aircraft;

and wherein at the time when the aircraft starts to clime or around 10 seconds or 20 seconds after the aircraft starts to climb, the jitter detection apparatus, the data acquisition apparatus or the message generation apparatus initiates detection of jitter;

or when the aircraft starts to climb at a speed larger than 260 knots, the jitter detection apparatus, the data acquisition apparatus or the message generation apparatus initiates detection of jitter;

or when the aircraft is in a steady-state cruise condition or around 40 seconds after the aircraft is in a steady-state cruise condition, the jitter detection apparatus, the data acquisition apparatus or the message generation apparatus initiates detection of jitter.

2. The system of claim 1, further comprises: a mode comparison apparatus, arranged to estimate a component where jitter might occur by comparing frequency and direction information of the aircraft jitter with jitters caused by already-known jitter sources.

3. The system of claim 1, wherein the jitter detection apparatus comprises an inertial navigation computer of aircraft, an inertial navigation platform or an accelerometer with a three-axis gravity acceleration sensor.

4. The system of claim 1, wherein the data acquisition apparatus comprises DMU, QAR or FDR of the aircraft, or a high frequency sampling independent hardware apparatus.

5. The system of claim 1 further comprises a message generation apparatus and a communication apparatus, the message generation apparatus being arranged to generate a jitter data message according to the acceleration data in two directions obtained by the data acquisition apparatus; the communication apparatus being arranged to transmit the jitter data message to the jitter determination apparatus on the ground via an air-ground data link system.

6. The system of claim 1 further comprises a jitter recording starting apparatus.

7. The system of claim 1, wherein the jitter determination apparatus is arranged to determine frequency spectrum and energy information of the jitter according to the acceleration in two directions within a time period obtained by the data acquisition apparatus.

8. The system of claim 7, wherein the jitter determination apparatus is arranged to process acceleration data in two directions of pitch and yaw of the aircraft within a time period via Fourier Transform, and obtains spectrum distribution of the jitter.

9. The system of claim 7, wherein the jitter determination apparatus is arranged to process acceleration data in two directions of pitch and yaw of the aircraft within a time period via Smooth-Pseudo Wigner-wille Distribution and/or Wavelet Transform, and obtains energy distribution of the jitter.

10. The system of claim 9, wherein the jitter determination apparatus is arranged to determine the occurrence of a jitter when the jitter energy exceeds a preset threshold value.

11. The system of claim 10, wherein the preset threshold value is energy density of the jitter larger than 150db, and amplitude of the jitter after being processed via Fourier Transform larger than 0.0003 m2/s/Hz.

12. The system of claim 2, wherein the mode comparison apparatus is arranged to determine source of the jitter in combination with location information of the jitter.

13. A method for detecting an aircraft jitter in the form of unstable aircraft structural oscillations, comprising:

detecting accelerations of pitch and yaw of the aircraft using a jitter detection apparatus;

obtaining accelerations in the two directions detected by the jitter detection apparatus using a data acquisition apparatus;

extracting frequency spectrum and energy information according to the accelerations in two directions obtained by the data acquisition apparatus using a jitter determination apparatus, and

comparing the extracted frequency spectrum with a threshold value and the energy information with another threshold value to determine whether the aircraft jitters using the jitter determination apparatus;

and initiating detection of jitter during the climb or cruise stage of the aircraft;

and wherein at the time when the aircraft starts to climb or around 10 seconds or 20 seconds after the aircraft starts to climb, initiating detection of jitter;

when the aircraft starts to climb at a speed larger than 260 knots, initiating detection of jitter;

or, when the aircraft is in a steady-state cruise condition or around 40 seconds after the aircraft is in a steady-state cruise condition, initiating detection of jitter.

14. The method of claim 13 further comprises estimating a component where jitter occurs by comparing frequency and direction information of the aircraft jitter with jitters caused by already-known jitter sources.

15. The method of claim 13 further comprises generating a jitter data message according to acceleration data in two directions of the aircraft obtained by the data acquisition apparatus.

16. The method of claim 15 further comprises transmitting the jitter data message to the ground via an air-ground data link system.

17. The method of claim 13 further comprises processing acceleration data in two directions of pitch and yaw of the aircraft within a certain time period via Fourier Transform, and obtaining spectrum distribution of the jitter.

18. The method of claim 13 further comprises processing acceleration data in two directions of pitch and yaw of the aircraft within a certain time period via Smooth-

Pseudo Wigner-ville Distribution and/or Wavelet Transform, and obtaining energy distribution of the jitter.

19. The method of claim 18 wherein the another threshold value is energy density of 150db, and the threshold value relates to an extracted frequency spectrum fourier transform amplitude of 0.0003 m2/s/Hz.

20. The method of claim 14 further comprises determining source of the jitter in combination with location information of the jitter.

21. An aircraft jitter detection system for detecting jitter in the form of unstable aircraft structural oscillations, comprising:

a jitter detection apparatus arranged to detect and process acceleration data in two directions of pitch and yaw of the aircraft within a time period via Smooth-Pseudo Wigner-wille Distribution and/or Wavelet Transform, and obtain energy distribution of the jitter;

a data acquisition apparatus arranged to obtain accelerations in two directions detected by the jitter detection apparatus, and

a jitter determination apparatus arranged to (a) extract frequency spectrum and energy information of the jitter according to the accelerations in the two directions obtained by the data acquisition apparatus, (b) determine frequency spectrum and energy information of the jitter according to the acceleration in two directions within a time period obtained by the data acquisition apparatus, and (c) determine the occurrence of a jitter when the jitter energy exceeds a preset threshold value, wherein the preset threshold value is energy density of the jitter larger than 150db, and amplitude of the jitter after being processed via Fourier Transform larger than 0.0003 m2/s/Hz;

wherein the jitter detection apparatus, the data acquisition apparatus or the message generation apparatus initiates detection of jitter during the climb or cruise stage of the aircraft;

and wherein at the time when the aircraft starts to clime or around 10 seconds or 20 seconds after the aircraft starts to climb, the jitter detection apparatus, the data acquisition apparatus or the message generation apparatus initiates detection of jitter; or when the aircraft starts to climb at a speed larger than 260 knots, the jitter detection apparatus, the data acquisition apparatus or the message generation apparatus initiates detection of jitter; or when the aircraft is in a steady-state cruise condition or around 40 seconds after the aircraft is in a steady-state cruise condition, the jitter detection apparatus, the data acquisition apparatus or the message generation apparatus initiates detection of jitter.