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NOISE CONTROL FOR A BETTER ENVIRONMENT

Study of organized data processing method complement each other of aircraft noise and flight path in aircraft noise monitoring

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ABSTRACT

The performance of the aircraft improved, the way of operation was devised, and the noise situation around the airport was improved as a result. However, the introduction of a new operation method such as area navigation causes low-level and high-frequency aircraft noise problems, monitoring low-level aircraft noise under environmental noise becomes important, noise detection and sound source identification has become an issue. On the other hand, we observe the flight path and disclose it as information or use it for noise prediction. Trying to associate the track data with the result of the noise monitoring is quite difficult because the difference between the aircraft and the background noise is small and the noise event cannot be observed even if the aircraft fly near the monitoring point. On the other hand, aircraft not equipped with ADS-B are still operating in Japan. The flight path of such aircraft, small passenger compact aircraft and military aircraft cannot be acquired unless it is a pseudo radar type observation device. Therefore, we examined a method to comprehensively complement the results of noise monitoring and observation of multiple flight paths and to comprehensively grasp the operational status of aircraft around the airport.

Keywords: Aircraft noise monitoring, Flight path monitoring, Complement.
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1. INTRODUCTION

Aircraft performance has been improved and aircraft noise levels are being reduced. In addition, flight methods such as sea flight and CDA are also devised. Therefore, scenes where low-level, high-frequency aircraft noise is focused on are increasing. Monitoring of low-level aircraft noise is difficult, and is often not detected as a noise event because the level difference between environmental noise and aircraft noise is small. In Japan, "Guidance Manual for Measurement and Evaluation of Aircraft Noise" defines a duration of noise level fluctuation LASmax-10 dB as a single noise event. This definition is necessary that precision is good and measures SEL in the environment where the plane noise is revealed. When level differences between environmental noise and aircraft noise are small, I may detect a level change section of LASmax-10dB, but energy except the aircraft noise gets mixed with the section. Therefore, the judgment that should use SEL of this section for an evaluation of the aircraft noise is difficult. On the other hand, this method cannot grasp all of flying aircraft around monitoring station. I can refer to the noise event number of times that I counted by the automatic monitoring mentioned above to predict the plane noise because conditions such as a model, flight path, the times of flight are necessary, but "it is the number of times that heard the sound that seems to be an aircraft" and is not times of flight. There are several flight path observation methods used for aircraft noise observation. Although the aircraft traffic control system can know the position of all aircraft, in Japan, the flight path data obtained by the control is not disclosed. So, in aircraft noise monitoring, we cannot use public flight path data. Therefore, we are also working on flight path monitoring. In the new control system called ADS-B, the aircraft itself knows its position and broadcasts latitude / longitude, altitude, speed, aircraft specific information, etc. However, although ADSBs are often used for new models and international flights, aircraft that are not equipped with domestic aircraft and small aircraft are still active. Receiving an ADSB is relatively easy, but it can not be covered by itself. Therefore, it is necessary to devise measures to comprehensively observe the flight path, and combined ADSB and PSSR. Then we examined the complementary relationship between acoustic data and track data.

2. CHARACTARISTIC OF LOW-LEVEL NOISE

The noise monitor that conforms to IEC 61672-1 Class 1 is used for environmental noise monitoring. The noise level LAS continuously records values every 100 ms. At the same time, record the direction of the sound arrival. Direction of sound arrival data is obtained from the time difference of sound reaching four microphones. Direction of sound arrival is also calculated every 100ms and stored in synchronization with the noise level.

If the flight noise can be heard, the aircraft passes above, so the sound heard from above can be judged as an aircraft. If a ground sound such as a car is a sound source, it is indicated that the sound source is at the same height as or lower than the microphone. This naturally depends on the installation situation of the microphone. In addition, since the road noise and noise arrival direction data on the ground travels along the road, there is a feature that exists within a specific range. On the other hand, instead of a narrow route like a road, there are variations in flight routes depending on the traveling direction, the wind direction, and the destination.

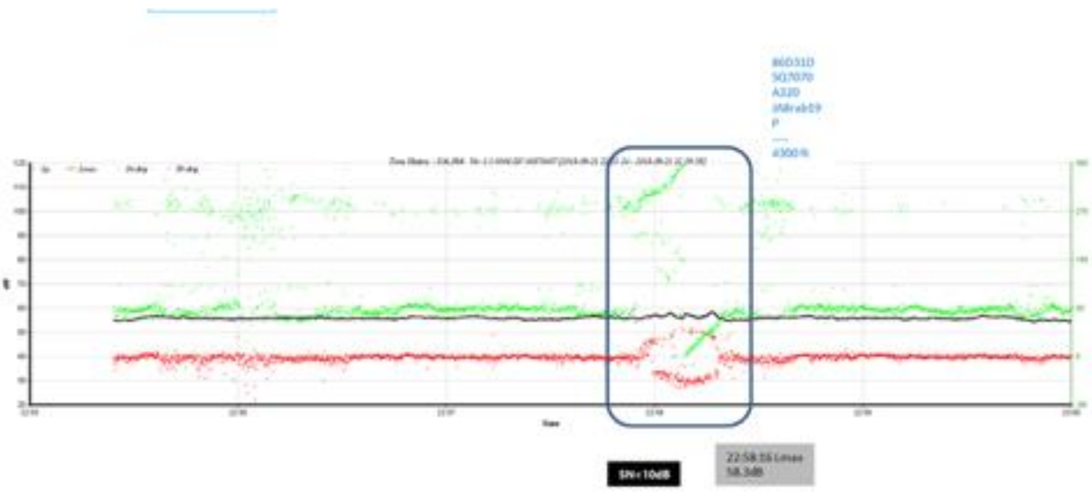

Figure 1 Example : Time history of low-level aircraft noise and direction of sound arrival.

The example of the aircraft noise of a noise level with a small level difference with environmental noise is shown. The black solid line is the fluctuation of LAS 100 ms dB. The elevation angle (deg) of the arrival direction of the sound is shown by a red point, and the azimuth angle (deg) is shown by a green point. The level fluctuation in this example is about 5 dB. The direction of arrival of the sound shows a change in elevation, and the azimuth is moving from east to west. From here, it can be recognized that there is a sound source moving in the sky.

Because noise level fluctuations are small, the duration of the aircraft noise can not be determined, but it can be detected that the aircraft noise was heard. It is thought that the machine and the operator can grasp this flight from the change pattern of elevation and azimuth. First of all, it is not a method of detecting noise events by noise level fluctuation, but by detecting noise events from changes in acoustic features, it is possible to raise the flight detection rate of aircraft.

In this example, it is the sound when A320 passes at 4500 ft approximately 2 km north of the measurement point.

3. APPROACH TO FLIGHT PATH OBSERVATION

We are researching flight path observation methods and data processing methods as input for aircraft noise observation and aircraft noise prediction. There are two flight path observation methods we selected: ADS-B (Automatic Dependency Surveillance Broadcast) and PSSR (Passive Secondary Surveillance Radar). The following is an example of observation data of ADSB and PSSR. The same flight departing and arriving at Haneda Airfield is plotted for comparison.

Figure 2 Compalition between ADSB flight path and PSSR flight path

As compared with PSSR, ADSB has better position accuracy than PSSR, as shown in the comparison of flight path maps. Therefore, in the case of flight paths observed in both ADSB and PSSR, analysis processing should be performed using only ADSB, and only PSSR is observed. If it can be done, analysis processing can be performed using PSSR.

Although PSSR can be used to monitor the flight paths of all civilian aircraft around the airfield, there are flight paths that can not be observed even with PSSR because there are aircraft whose transponders are turned off in formation flight for military aircraft.

3. INTEGRATION OF ACOUSTIC DATA AND FLIGHT PATH DATA

3.1 Acoustic aircraft proximity detection

Noise events at monitoring points are observed from noise level fluctuations observed at the place where NMT is installed. The LAE of this noise event is the basic measurement of Lden obtained from the measured data. If the source of each noise event is an aircraft, the number of events is the number of aircraft noise occurrences. This is not a flight number of aircraft.

Even if the noise level fluctuation is small and it does not become a noise event, if the aircraft is flying, it may be able to be detected using acoustic features. We call this an acoustic aircraft proximity event. As described above, it detects the movement of the aircraft from the direction of sound arrival information and detects the "acoustic aircraft proximity event", so the approximate movement direction is known. Depending on the arrangement of measurement points, it is possible to identify the runway used and take-off and landing times. As a result, you can list estimated departure and arrival times, departure and arrival classifications, runways, and so on.

3.2 FLIGHT EVENT DETECTION BY FLIGHT PATH

By observing the flight path with ADSB and PSSR, you can estimate the runway used and the takeoff and landing time from the flight path of each aircraft. Then you can list estimated departure and arrival dates, take-offs and landings, runways, identification information (ADDRESS and SQUAWK), etc. However, as mentioned above, there is a problem that the flight path of some military aircraft cannot be observed depending on the operation.

3. SUMMARY

Aircraft noise monitoring constantly monitors, detects and records aircraft noise events. When the level difference between environmental noise and aircraft noise is small, some acoustic events are not detected as aircraft noise events. This is data that cannot be used for noise assessment of low signal-to-noise ratio, but it is possible to capture aircraft characteristics from acoustic information and detect them as aircraft flight events. We do this at acoustic aircraft proximity events and so on. You can combine aircraft noise events and acoustic aircraft proximity events to create a flight event list acoustically. However, depending on the flight path, it may not be observable.

On the other hand, flight routes are also used for observation and prediction of aircraft noise. ADSB and PSSR were used for flight path observation in consideration of accuracy and completeness. By analysing the flight path, a flight event list can be created, but some military aircraft cannot be observed.

By calculating the logical sum of the respective flight event lists complementarily to each other, it is possible to obtain the more accurate number of times of operation of the aircraft.

6. REFERENCES

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