Airport Bird Deterrence Solution

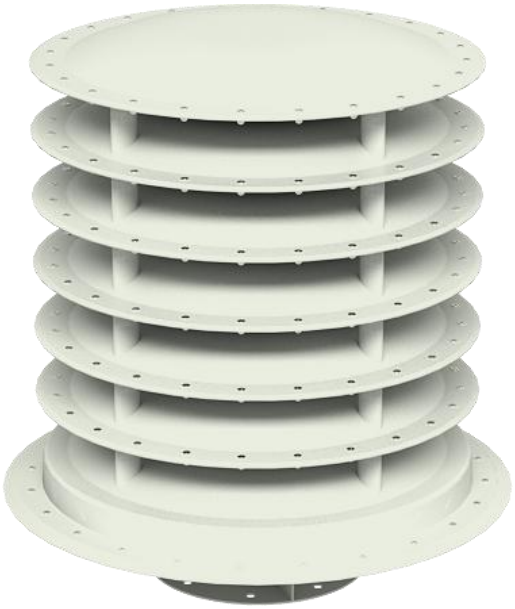
I. Requirement Background

Airport bird deterrence is a core link in ensuring aviation safety, and the risk of bird collisions with aircraft cannot be underestimated. Once a bird strike incident occurs, the engine may inhale birds, leading to mechanical failures, and the windshield may break, affecting the pilot's vision and other fatal dangers. In history, many flights have been forced to land or even suffered air crashes due to bird strikes. When bird flocks are inhaled into the engine, it will cause mechanical failures, and hitting the windshield will endanger the pilot's vision and life safety. At the same time, the gathering of bird flocks will also interfere with the airport radar signal, resulting in errors in the navigation and monitoring system. The remaining feces and other pollutants will affect the runway friction coefficient, threatening the takeoff and landing of the aircraft. With the development of the air transportation industry, the frequency of flight takeoffs and landings has increased, and the risk of bird strikes has further risen. Reducing the probability of bird strikes through professional bird deterrence means can not only avoid major safety accidents and economic losses but also ensure the normal operation of airport equipment, maintain the ecological balance of the airport and its surrounding areas, and build a solid defense line for aviation safety.

II. Core Equipment

1. Omnidirectional Acoustic Equipment

The equipment adopts advanced acoustic wave emission technology, which can cover and emit strong sound in all directions of 360°, forming an invisible "acoustic wall". This omnidirectional acoustic wave coverage avoids the risk that birds enter the core area of the airport from a specific direction due to the existence of acoustic blind spots.



The equipment can emit a variety of sounds that make birds feel fearful or uncomfortable. On the one hand, it simulates the sounds that may pose a threat to birds in nature, such as the loud noises of storms and thunder and lightning. These sounds are often associated with dangerous environments in the evolutionary process of birds. When birds hear similar sounds, they will instinctively have a fear psychology and then flee from the area. On the other hand, it plays the calls of bird natural enemies, such as the tweets of eagles, falcons and other raptors. It uses the birds' innate fear of natural enemies to trigger their stress response, prompting birds to quickly move away from the sound source, build a sound barrier around the core area of the airport, make birds instinctively avoid the area, and prevent birds from entering the core activity range of the airport from the root, so as to create a safe airspace environment for the takeoff and landing of aircraft.

2. Directional Acousto-Optic Equipment

The bird deterrence principle of the equipment integrates two core mechanisms of optical stimulation and acoustic deterrence, and realizes precise bird deterrence by virtue of the unique advantages of acousto-optic collaboration.

The equipment is equipped with green light dazzling and white light searchlight functions. Because birds are extremely sensitive to light, the white light searchlight function can directly stimulate the birds' eyes through high-intensity light irradiation during the day, make them have visual discomfort, interfere with their normal flight judgment, and thus take the initiative to stay away from the light source direction. At night, the green light dazzling function plays a leading role. The bird retina is sensitive to the green light of a specific wavelength. The irradiation of the green light will strongly interfere with the transmission of their visual signals, disrupt the flight rhythm, and force the birds to fly away quickly.

The equipment can also emit high sound pressure level sound waves, which simulate the sounds that make birds fearful in nature, such as the roars of natural enemies and the roars of natural disasters. The high-intensity sound waves entering the birds' ears will cause their strong stress response, produce fear emotions, and prompt the birds to flee from the sound wave coverage area.

The directional technology is the key to achieving precise bird deterrence. Through the advanced beam control technology, the equipment can accurately adjust the emission angle and range of the acousto-optic according to the position and flight direction of the bird flock, ensure that the acousto-optic energy is concentrated on the target bird flock, avoid energy dispersion, improve the bird deterrence efficiency, and reduce the impact on the ecological environment of the surrounding non-target areas while ensuring the safety of the airport.

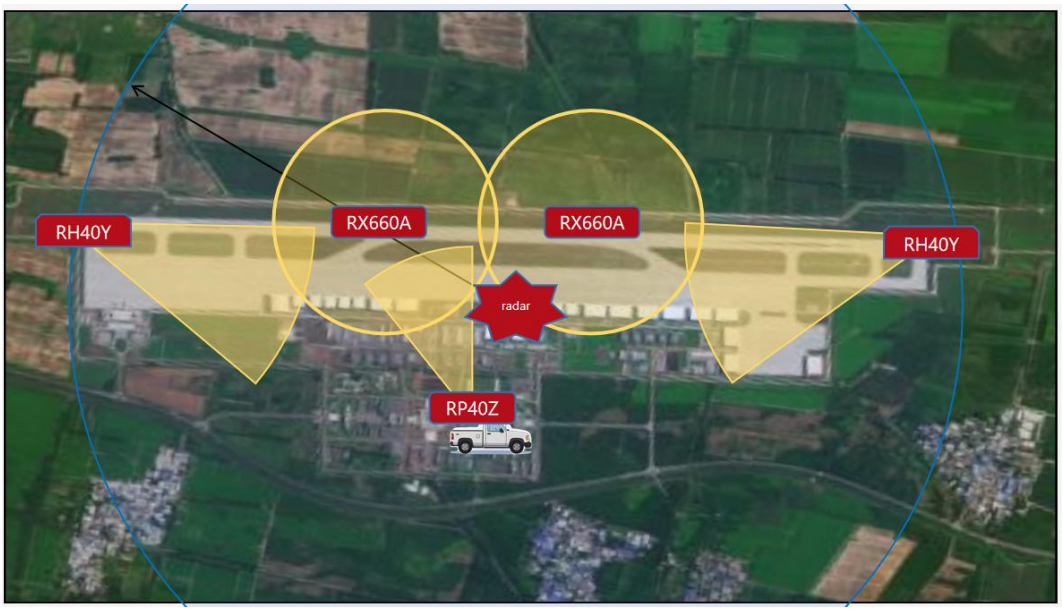
3. Vehicle-Mounted Directional Acoustic Equipment

The equipment takes mobility and precise acoustic wave deterrence as the core, and realizes the flexible and efficient bird deterrence function through the deep adaptation with the airport patrol vehicle.

The equipment can flexibly adjust the emission direction and intensity of the sound wave according to the patrol route and the gathering situation of the bird flock, and realize the directional playback of strong sound during the movement. When the gathering of the bird flock is found, the patrol vehicle can quickly arrive at the scene. The operator controls the equipment to rotate to the appropriate angle according to the position and flight direction of the bird flock, and accurately projects the sound wave with high sound pressure to the area where the bird flock is located. It can directionally disperse bird flocks, quickly solve the problem of local bird congregation, and improve the flexibility and timeliness of bird deterrence work.

The equipment is mounted on the patrol vehicle and powered by a 24V vehicle-mounted power supply to ensure long-term stable operation in the airport area. Its main structure includes a high-precision acoustic wave transmitter and a rotatable acoustic wave directional device, which can quickly adjust the emission direction and coverage range of the acoustic wave according to actual needs. Under the strong acoustic wave deterrence, birds will quickly flee from the acoustic wave coverage area in order to avoid potential dangers. In addition, the equipment can intelligently adjust the frequency and intensity of the acoustic wave according to the auditory map of common birds in the airport, and while efficiently driving away the bird flock, minimize the unnecessary impact on the surrounding ecological environment, and realize the balance between flexible bird deterrence and ecological protection.

II. Scheme Implementation



- **Radar Monitoring**: Deploy a high-precision radar system to carry out real-time and all-round scanning of the airport airspace. The radar can quickly and accurately locate the position, quantity and flight track of the bird flock within 10 seconds, and judge whether the bird flock poses a threat to the takeoff and landing of the aircraft through the advanced data analysis algorithm. Once a dangerous situation is detected, the radar system will immediately trigger the deterrence response mechanism, striving for precious time for the subsequent bird deterrence operation.

- **Omnidirectional Acoustic Wave Pre-Deterrence**: When the radar monitors that the bird flock is approaching the airport periphery, the omnidirectional acoustic wave equipment is started first, and strong sound and warning sound are emitted in a 360° coverage, forming the first protective barrier on the airport periphery. This pre-deterrence measure can drive away the bird flock in advance before the bird flock approaches the core area of the airport, reduce the possibility of the bird flock entering the airport interior, and strive for time and space for the subsequent more precise deterrence means.

- **Fixed Directional Strong Sound Laser**: When the bird flock breaks through the protection of the omnidirectional acoustic wave equipment and enters the range of 500 meters from the airport, the directional acousto-optic equipment is automatically started. The bird flock is accurately deterred by using the acoustic wave of high sound pressure level and the light dazzling technology. The equipment adjusts the emission angle of the acoustic wave and the light according to the specific position and flight direction of the bird flock to ensure that each deterrence operation can accurately act on the target bird flock and realize efficient deterrence.

- **Vehicle-Mounted Directional Strong Sound**: For the bird flocks sporadically gathered in the areas such as the airport runway periphery and the apron, the vehicle-mounted directional acoustic wave equipment and the patrol vehicle play a role in cooperation. The patrol vehicle patrols continuously in the airport area. Once the bird flock is found, the vehicle-mounted equipment is started immediately, and the bird flock is directionally deterred during the movement. Its flexible mobility can quickly reach the

gathering place of the bird flock and timely solve the local bird damage problem to ensure the safety of each area of the airport.

- **Intelligent Linkage**: The whole bird deterrence system realizes intelligent linkage, and the radar monitoring data is used as the core drive to provide real-time information support for the acousto-optic equipment. The system automatically matches the most appropriate sound effect according to factors such as the distance of the bird flock from the airport and the size of the bird flock. For example, when the bird flock is far away, the relatively mild warning sound is played for driving away; when the bird flock is close to the core area of the airport, the strong deterrence sound effects such as the calls of bird natural enemies are played. This layered deterrence mode by distance can not only efficiently drive away the bird flock but also minimize the impact on the ecological environment to the greatest extent, and realize the balance between the bird deterrence effect and ecological protection.

IV. Scheme Advantages

1. Multi-Level Protection

The scheme constructs a multi-level bird deterrence system from the airport periphery to the core area. The omnidirectional acoustic wave equipment forms the periphery protection barrier for pre-deterrence; the directional acousto-optic equipment and the vehicle-mounted directional acoustic wave equipment respectively carry out precise deterrence for the bird flocks at different distances and positions. Each link is closely coordinated, layers of defense are set up, and the airport airspace safety is guaranteed in an all-round way.

2. Intelligent Operation

With the help of the high-precision radar and the intelligent linkage system, the automation and intelligence of the bird deterrence process are realized. The equipment can automatically adjust the working mode and parameters according to the actual situation of the bird flock without frequent manual intervention, which greatly improves the bird deterrence efficiency and reduces the possibility of human operation errors at the same time.

3. High Efficiency and Safety

Through the advanced acousto-optic technology and the scientific deterrence strategy, the bird flock can be quickly and effectively driven away, the bird strike risk is significantly reduced, and the safe takeoff and landing of the flight are guaranteed. Compared with the traditional bird deterrence mode, the scheme has a more remarkable deterrence effect and can deal with various complex bird damage situations.

4. Ecological Friendliness

In the bird deterrence process, the protection of the ecological environment is paid attention to. By reasonably selecting the sound effect and controlling the deterrence intensity,

the unnecessary harm to the birds is avoided, the interference to the surrounding ecological system is reduced, the harmonious unity of aviation safety and ecological protection is realized, and the concept of sustainable development is met.