

低空風切警報系統的發展及現況

Development of low-level windshear detection system: from past to present

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摘 要

低空風切為發生於離地面1,600呎以下風速或風向的突然變化，有機會令飛機偏離原本採取的航道，影響起降安全。在1943至2023年期間，全球共有132次由低空風切導致的航空事故，造成近2,000人喪生，因此多個國家相繼投入大量資源，發展低空風切偵測技術及設備。本報告將簡介低空風切偵測技術的發展過程，包括自1970年代起採用的低空風切警報系統(Low-Level Windshear Alert System; LLWAS)，透過多個地面測風計的觀測網格，以演算法推算風切強度及位置。此外，利用遙感探測技術，如雷達(Radar)、聲波雷達(Sodar)及光達(Lidar)，透過都卜勒效應觀測一定範圍的風場並偵測風切的發生，為現今多國大型機場採用的主流設備。本報告亦介紹臺灣本地，以及鄰近國家包括中國、日本、韓國、新加坡等地的機場，在低空風切警報系統上的使用現況。

關鍵字：風場觀測、低空風切、機場氣象觀測、遙感探測

Abstract

Low-level wind shear refers to sudden changes in wind speed or direction below 1,600 feet above ground level, which can potentially cause aircraft to deviate from their intended flight paths, compromising takeoff and landing safety. Between 1943 and 2023, there have been 132 aviation accidents globally attributed to low-level wind shear, resulting in nearly 2,000 fatalities. Consequently, several countries have invested heavily in the development of detection technologies and equipment for low-level wind shear.

This presentation provides an overview of the evolution of low-level wind shear detection technologies, including the Low-Level Windshear Alert System (LLWAS) adopted since the 1970s. LLWAS utilizes a network of ground-based anemometers and algorithms to estimate shear intensity and location. On the other hand, remote sensing technologies such as radar, sodar (sound detection and ranging), and lidar (light detection and ranging) are employed to observe wind fields over a specified area through Doppler effect and detect wind shear occurrences. This is now standard equipment at many international airports worldwide.

The report also discusses the current usage of low-level wind shear warning systems at airports in Taiwan, and neighboring countries including China, Japan, South Korea, and Singapore.

Key words : wind observation, low-level windshear, airport meteorological observation, remote sensing