International Civil Aviation Organization

Third Meeting of the Asia/Pacific Air Traffic Management Automation System Task Force (APAC ATMAS TF/3)

Video Tele-Conference, 8– 10 June 2022

Agenda Item 4: ATM Automation System Implementation by States

4.1 ATMAS Implementation Status and Experience

EXPLORATION AND IMPLEMENTATION OF AN OPTIMIZED MSAW

(Presented by China)

SUMMARY

Based on the polygonal MSAW warning area, this paper summarizes the empirical data of SIDs/STARs procedures and the approach procedures, and proposes a new optimized MSAW around the airport combining four regions layer by layer.

1. INTRODUCTION

1.1 The MSAW (Minimal Safe Altitude Warning) function of ATMAS, is mostly realized by polygonal warning areas, mosaic warning areas, and airport inhibition areas. The polygonal warning area of MSAW is commonly used in the route area. The Mosaic warning areas are often used in approach and airport areas. Due to the characteristics of the minimum safe altitude near the airport, the flight will inevitably trigger the minimum safe altitude warning during the procedure of landing or departure.

1.2 The polygonal MSAW warning areas mainly come from the topographic data. The mosaic warning areas require minimal modularity to accurately predict flight landing and take-off trends. The characteristics of the mosaic area cause each change to bring a lot of data modification work.

1.3 Recently, China has carried out research on optimized MSAW region. It combines the four regions around the airport layer by layer, based on polygonal general MSAW regions and empirical data of flight arrivals and departures.

2. DISCUSSION

As more and more dual runways or multiple runways are put into operation, the STARs and SIDs are becoming more and more complicated. The MSAW function relies on the polygonal warning areas and the mosaic warning areas will face more challenges:

2.1 If the polygonal warning areas are used in the approach area, the landing flight will inevitably generate fake MSAW alerts.

2.2 If the MSAW is suppressed after the glide paths, ATMAS will lose the altitude monitoring on the landing aircraft.

2.3 With multiple runway operations, optimization of SIDs/STARs, and the use of mosaic warning areas in the approach, will bring a lot of data adjustments.

3. OPTIMIZED MSAW AROUND THE AIRPORT

3.1 Through years of practical experience in China. The MSAW polygonal general warning areas, the MSAW safe pipeline areas based on the procedures of SIDs/STARs, APM (Approach Path Monitor) areas, and the MSAW inhibition zone are established around the airport. The four regional segmentation settings, combined layer by layer, constitute the current optimal MSAW around the airport. As shown in Figure 1:

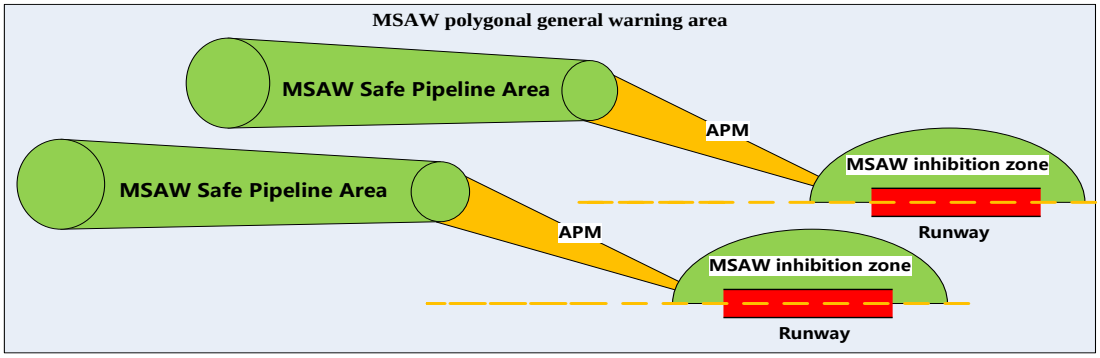

Figure 1: Optimized MSAW Around the Airport

Polygonal General Warning Area

3.2 The polygonal general warning area is superimposed with a certain safety height according to the obstacles on the ground. The advantage of the polygonal warning area is that the altitude data is officially released and will be revised regularly. The disadvantage is that the altitude data is too rough.

Safe Pipeline Area

3.3 The Safe Pipeline Area is to track the trajectory of the landing aircraft, and define a series of approach points through empirical data to form a gradient cylinder with decreasing height and decreasing radius.

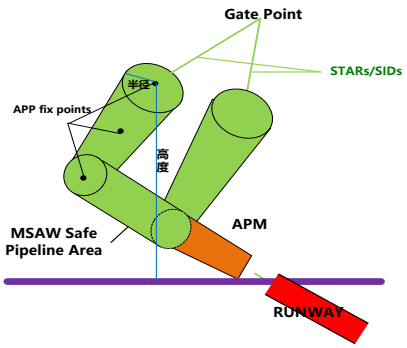

Figure2: The MSAW Safe Pipeline Area

3.4 The advantages of The Safe Pipeline Area are:

➢ Alerts have been reduced. The Safe Pipeline Area tracks the trajectory of the landing or departure flight, and considers the experience data of the STARs/SIDs procedures and the approach procedures. If the landing or departure flights are flying normally in the safety protection pipeline, the MSAW alarm will not be triggered.

➢ Missed alerts have also been reduced. If the aircraft leaves the safety protection pipeline, it will immediately enter the polygonal general warning area, and the system will issue an MSAW warning based on the actual altitude of the flight.

➢ More flexibility. The Safe pipeline area can be set according to different runways and different procedures, considering as many actual landing or departure procedures as possible.

APM (Approach Path Monitor)

3.5 As shown in Figure 3, the APM schematic diagram for a single runway. The upper picture is the top view; the lower picture is the side view. As long as the landing flight is implemented in the inclined trapezoidal cylinder, the alarm will not be triggered. However, if the flight deviates from this area or intends to deviate from this area, and APM alert will be triggered.

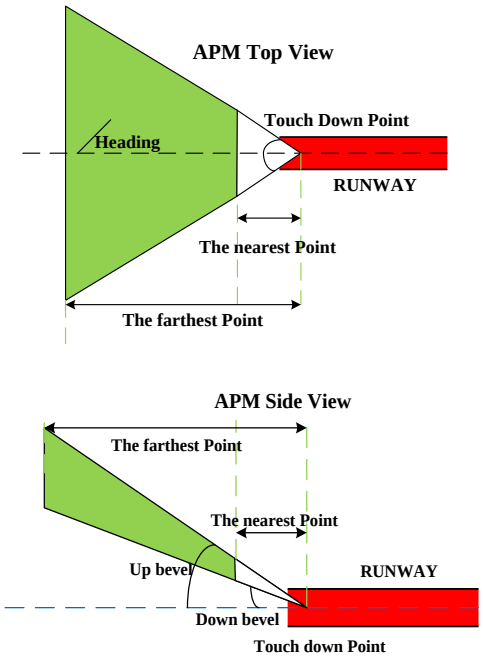

Figure3: APM Schematic Diagram

3.6 The advantages of the APM

➢ The alerts will be more accurate, compared to the vertical monitoring of MSAW. In the vertical altitude direction, it indicates that the flight is too low with Vertical Down Deviation (ADD) warning or too high Vertical Up Deviation (AUD) warning, and laterally, it can provide the Heading Deviation (AHD) warning or Lateral Deviation (ALD) warning.

➢ Multi-runway operation monitoring. The operation of dual runways or multiple runways can be taken into account in the Heading warning (AHD) and the lateral deviation warning (ALD) of the APM.

3.7 The boundary between the MSAW and APM area is recommended by the 《EUROCONTROL Guidance Material for Approach Path Monitor》, as shown in Figure 4.

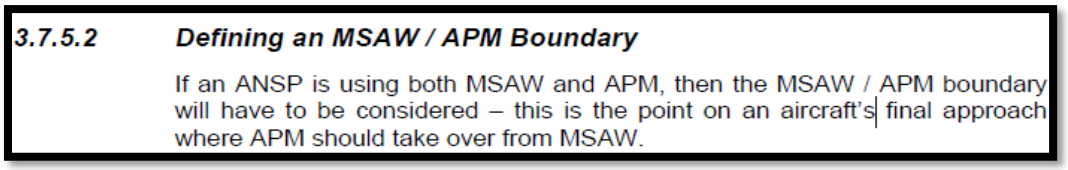

Figure 4: the Boundary between APM and MSAW

MSAW Inhibition Zone of the Runway

3.8 The MSAW inhibition zone of the runway follows the APM area. The inhibition area is a semi-cylindrical radiated with a certain radius from the center of the runway. As shown in Figure 5.

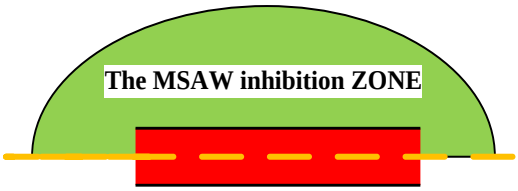

Figure 5: the MSAW Inhibition Zone of the Runway

4. APPLICATIONS

4.1 The following is a brief example of an application.

4.2 On 20th March, a landing flight VJC5316 triggered "ADD" (Vertical Down Deviation) alarms of the APM (as shown in Figure 6) in the ATM AS, indicating that the flight was below the glide path. It was two o'clock in the morning, and the aircraft was still a certain distance from the runway, the controller could not have visual contact with that flight. The display of the aircraft position in the glide path ILS window of the ATM AS and the alarm on the SDD remind the controller in time to avoid the incident of the aircraft hitting the ground.

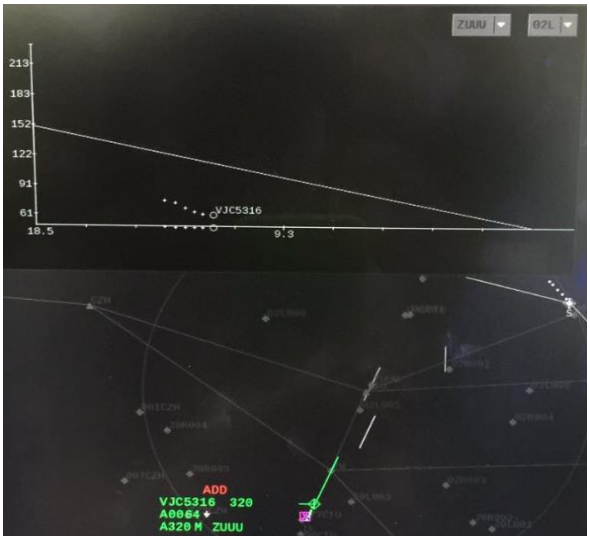

Figure 6: The HMI as the situation occurs

4.3 Civil Aviation of China will continue to optimize the MSAW and other functions of the ATM-AS, according to the operational needs of the site, to provide a more safe operation.

5. ACTION BY THE MEETING

5.1 The meeting is invited to:

a) note the information contained in this paper; and

b) discuss any relevant matter as appropriate

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