International Civil Aviation Organization

Fifth Meeting of the Asia/Pacific Air Traffic Management Automation System Task Force

(APAC ATMAS TF/5)

Chengdu, China, 5 – 7 June 2024

Agenda Item 4: ATM Automation System Implementation Experience by States

4.1 ATM Automation System Implementation Issues sharing

THE APPLICATION AND TUNING OF THE MTCD FUNCTION FOR ENROUTE CONTROL

（Presented by China）

SUMMARY

With intensive practice including the tuning of the relevant parameters, the MTCD function has achieved the expected effect. This paper presents the MTCD application experience in the Enroute control environment in Air Traffic Management Bureau of CAAC.

1. INTRODUCTION

1.1 Short-term conflict alert (STCA) is the main function of ATMAS to maintain safe separation between aircrafts. Since the typical STCA warning time is than 2 minutes, controllers are usually overwhelmed in resolving the conflicts when the alerts are raised. An earlier conflict alert function is urgently required, especially for the busy enroute area.

1.2 In 2015, The Flight Plan Conflict Function (FPCF) was introduced in ATMAS. This function predicts conflicts mainly based on the flight plan information, and can provide early and relatively accurate warning when the aircrafts strictly follow the route in the flight plan. However, the function has a limitation that the surveillance track information is not considered. False alerts and missed alerts can often occur, and as a result FPCP has not been effectively applied during the operation.

1.3 In 2019, the Medium Term Conflict Detection (MTCD) function was deployed in ATMAS. Different from the FPCF, MTCD is designed according to the characteristics of flights on the Enroute. By combining the track and flight plan information, the function can compute the potential conflicts by predicting the position and level of the aircraft with 240-480 seconds lookahead time.

2. DISCUSSION

2.1 MTCD Algorithm

2.1.1 Horizontal prediction

Predict the horizontal position of the track by determining whether the target adheres to the route.

a) If the flight direction is within the tolerance range, the flight is judged adhered, and the position is predicted according to the route.

b) If the flight deviates from (not adhere to) the planned route, the position is predicted along a straight line.

2.1.2 Vertical prediction

Vertical prediction is based on the Cleared Flight Level (CFL) or the Internal Flight Level (IFL)

a) Aircraft with CFL

CFL value is taken as the top or bottom of the predicted track level. The level range is also predicted according to the Rate Of Climbing/ Rate Of Descending (ROC / ROD) of the aircraft.

b) Aircraft without CFL

If the aircraft does not have CFL, the system will compute and suggest a most possible flight level based on the current flight level and ROC/ROD; this suggested level is IFL In the enroute area, all aircrafts fly on fixed levels; normally, the separation between adjacent levels is 1000ft.

When the ROC/ROD is less than a specific value, the aircraft is judged to maintain the level. When ROC/ROD is beyond a specific value, the aircraft is judged to climb or descend to another level.

The vertical model is established as below.

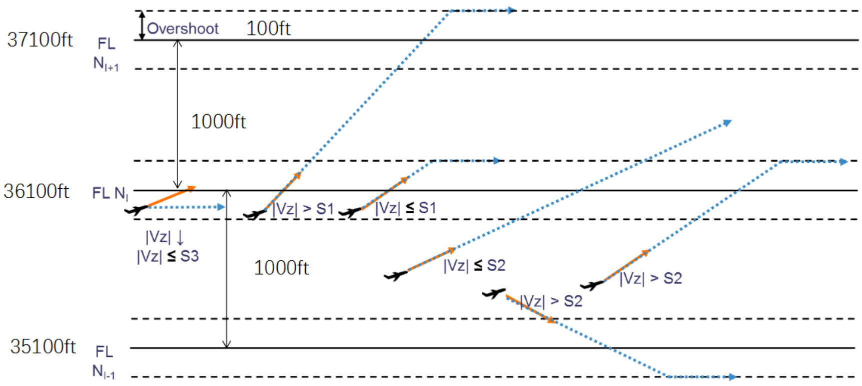


Figure 1 Vertical model of MTCD

The prediction accuracy is greatly improved due to the inclusion of trajectory and level information,

2.2 Application of MTCD

The MTCD function has been actively used in many scenarios. It is achieving the expected effect.

2.2.1 Warning of CFL

The Human Machine Interface (HMI) of ATMAS provides a two-dimensional view, so that only horizontal separation can be seen directly. The controller needs to build a vertical view in his mind for vertical separation. Therefore, potential vertical conflict is not easily recognized. When the CFL is issued leading one aircraft to fly across multiple levels, controllers are prone to ignore the other aircrafts in the crossed levels. In this case, MTCD can provide CFL warning via vertical detection to remind the controller of the negligence.

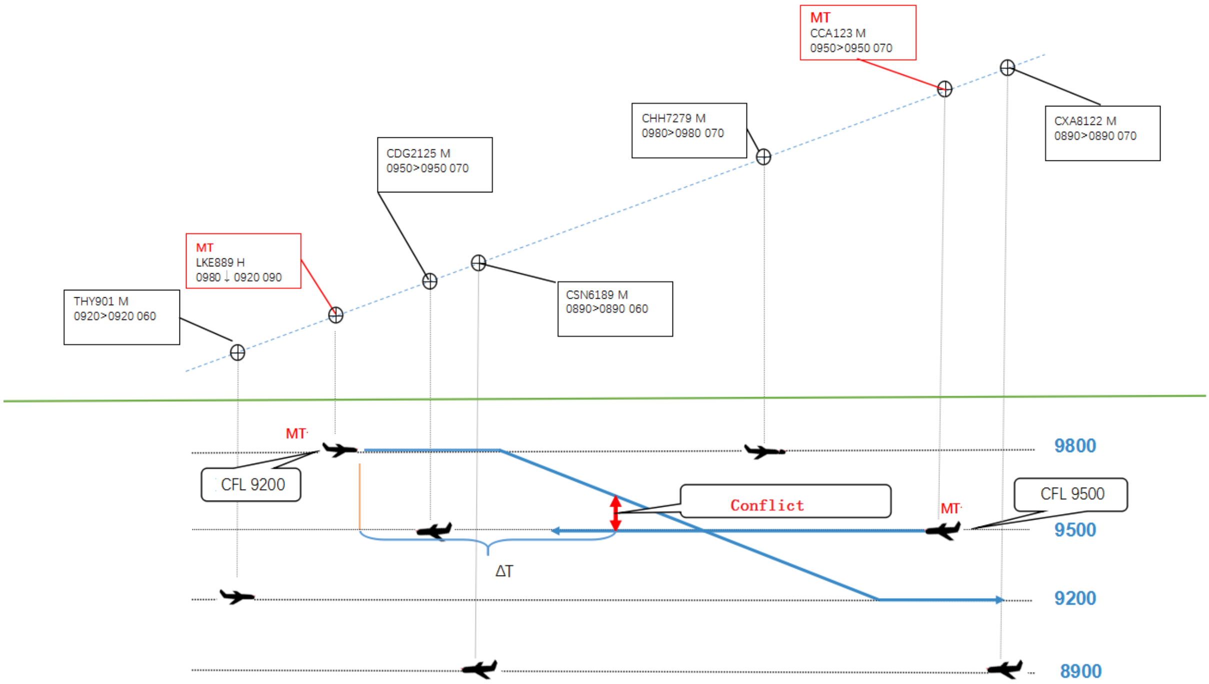


Figure 2 MMI horizontal view vs vertical view

2.2.2 Warning of rerouting

When the flight encounters thunderstorms, rerouting is necessary for the flight. However, the reroute can possibly cause another conflict. In that case, MTCD raises an alert whilst the rerouting is executed, which helps the controllers to be aware of the conflict in advance and plan for an appropriate alternative.

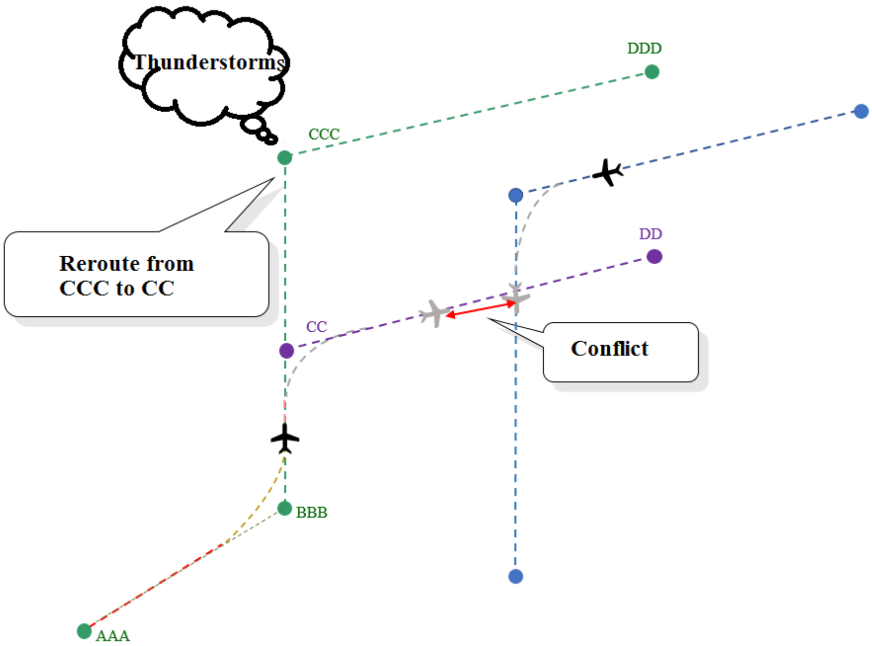


Figure 3 Reroute Warning

2.2.3 Prediction with the uncontrolled aircraft

Uncontrolled aircraft may cause conflicts with the controlled aircraft. Uncontrolled aircraft have no CFL or planned route, and their flight characteristics are uncertain. Compared to controlled aircraft, conflict detection are relatively complicated.

For the MTCD model, the position of the uncontrolled aircraft are predicted based on offline parameters. This requires tuning of the MTCD parameter to reduce false alarm probability and improve the accuracy of the alert.

2.3 Comparison with STCA

a) MTCD is predicted earlier. Once the controller issues a clearance with potential conflict, the system raises an alert.

b) MTCD reduces the occurrence rate of STCA and improves the safety of air traffic operation.

c) MTCD is more suitable for enroute control, providing earlier warnings and giving the controller enough time to deal with the conflict.

d) MTCD configuration parameters are diverse and flexible. Multiple parameters can be tuned to adapt to adapt to different operational requirements;

2.4 Parameters tuning of MTCD

Since the deployment of the MTCD function, the parameters have been constantly tuned to solve the operation issues. The tuning improves the accuracy of the alert and minimizes the number of false alarms.

a) Lookahead time tuning

Based on the experience of the operation, the maximum of 480 seconds is set to 360 seconds, and the probability of false alarms is reduced.

b) Set inhibition area in TMA

Since the flight maneuvering, MTCD is not suitable in TMA and therefore is inhibited.

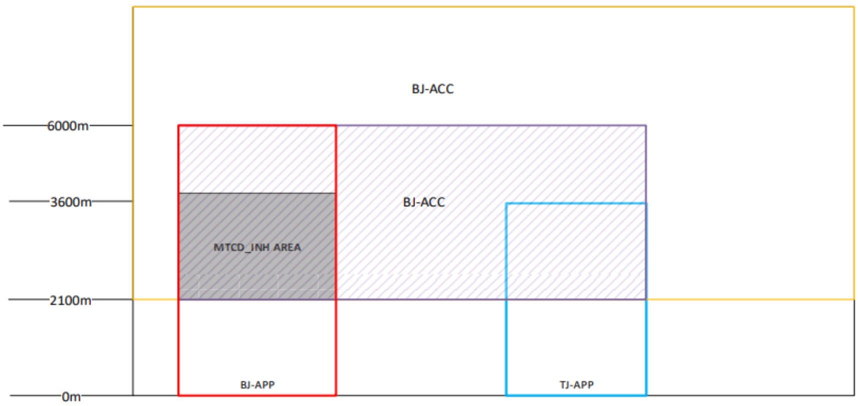


Figure 4 Active MTCD volume tuning

c) Correct the irrationality of the algorithm to avoid false alarms.

When two flights fly on adjacent levels, slight changes of ROC / ROD can trigger the recalculation of flight level, and offline defined vertical separation 787ft(240m) is infringed. The two flight actually maintain their level, but a false alarm occurs in that case.

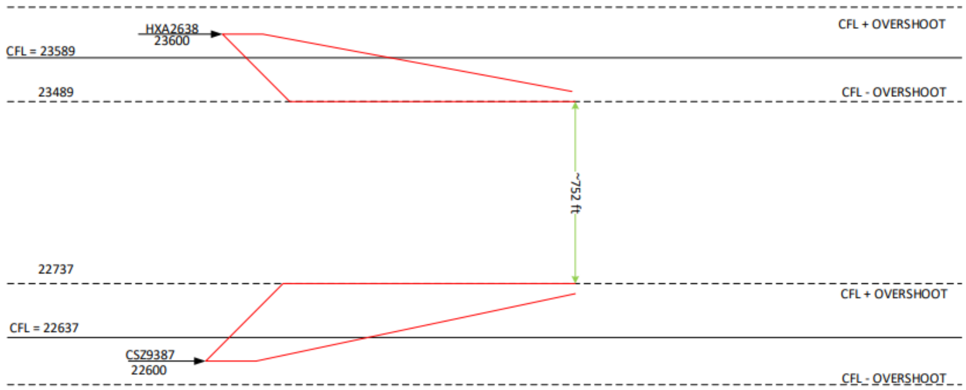
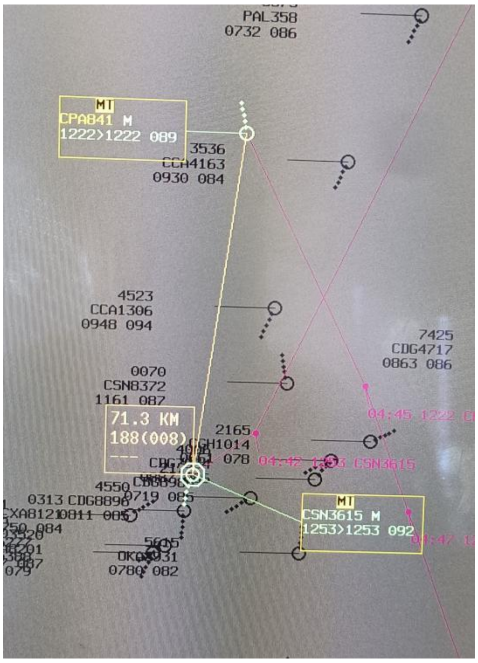


Figure 5 ROC/ROD slight change triggers alarm

d) RVSM top layer tuned for the coverage

When RVSM was implemented, the top layer defined in the system was 41000ft, which did not cover the flight level 12530m (41108.9ft). Therefore MTCD adapted the non-RVSM separation of 600m for the aircrafts on level 12230m. False alerts were raises, while a 300m vertical separation was actually eligible. After tuning the RVSM top layer to cover the flight on level 12530m, the false alarm is cleared.



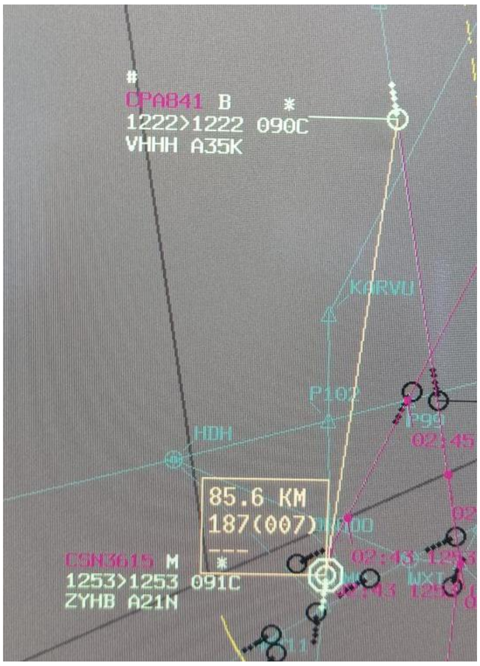


Figure 6 Tuning Before Figure7 Tuning After

2.5 Outlook for MTCD

Currently, the function of MTCD can indicate the position of the two alarm targets as below,

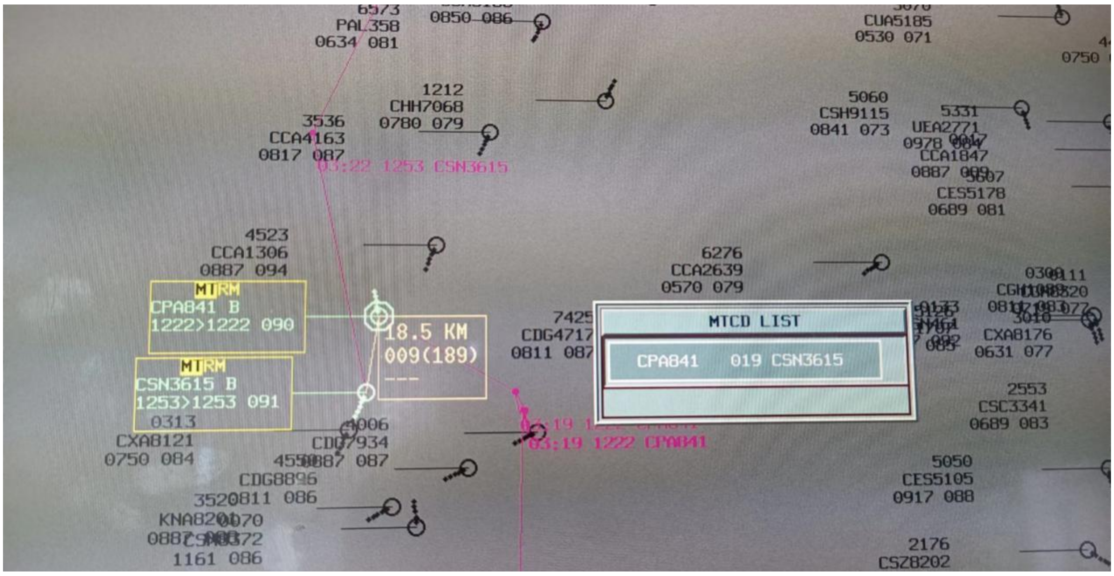


Figure 8 MTCD alert

For the future evolution of the MTCD function, conflict resolution advisory can be one of the direction to be explored. When conflict occurs, a reasonable route and level suggestion is expected to be shown to the controller, such as prompting climbing / descending to the optimal level and prompting the aircraft to take a reasonable route.

MTCD is mainly applied to the enroute control area. Parameter tuning will gradually meet the operation's needs. As a tactical tool, by extensive use, adaptive tuning and functional enhancement, MTCD will play a more influential role in the safety of air traffic management.

3. ACTION BY THE MEETING

3.1 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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